AD-A220 140

OCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; Distribution unlimited (2)
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): 13-89	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: US Army-Baylor University Graduate Program in Health Care; 6b. OFFICE SYMBOL (If applicable): Admin/HSHA-IHC	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code): Ft. Sam Houston, TX 78234-6100	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION; 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

DTIC ELECTE APR 09 1990 S D

11. TITLE (Include Security Classification)
A STUDY TO DETERMINE THE FEASIBILITY OF IMPLEMENTING A CART EXCHANGE DISTRIBUTION SYSTEM FOR MEDICAL SUPPLY SUPPORT WITHIN THE HOSPITAL

12. PERSONAL AUTHOR(S)
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13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Study	FROM Jul 84 TO Jul 85	Jun 85	94

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Health Care; Medical Supply; Supply Distribution
medical supplies; Sanitary [illegible]

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This study was conducted to determine if the cart exchange system is a viable method of medical supply distribution within Munson Army Community Hospital. The manpower costs of the current supply distribution system were assessed by a survey to all wards. A specific ward's medical supply usage was computed from the past year's requisitions. The medical supply usage was used to determine the stockage levels for a supply cart. The estimated time to inventory and stock carts on a recurring basis by supply warehouseman was computed. The difference in costs were analyzed. The cart exchange system would result in an overall cost savings. The author warned of potential problems to overcome in transitioning to this system, additional medical supply space would be required and two nursing positions would need to be given to medical supply.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION	
[X] UNCLASSIFIED/UNLIMITED [ ] SAME AS RPT. [ ] DTIC USERS		
22a. NAME OF RESPONSIBLE INDIVIDUAL: Lawrence M. Leahy, MAJ, MS	22b. TELEPHONE (Include Area Code): (512) 221-6345/2324	22c. OFFICE SYMBOL: HSHA-IHC

DD Form 1473, JUN 86 — Previous editions are obsolete. — SECURITY CLASSIFICATION OF THIS PAGE

A STUDY TO DETERMINE THE FEASIBILITY OF IMPLEMENTING A CART EXCHANGE DISTRIBUTION SYSTEM FOR MEDICAL SUPPLY SUPPORT WITHIN THE HOSPITAL

A Graduate Research Project

Submitted to the Faculty of Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Administration

by

Major Michael F. D'Agostino, MS, USA

June 1985

ACKNOWLEDGEMENTS

This project could not have been completed without the cooperation, assistance and support of many individuals. First, I wish to thank my Preceptor, Colonel Walter Rose, Deputy Commander for Administration, Munson Army Community Hospital. His philosophy during the residency year that "the object is to finish" was most helpful in providing the necessary time and resources for the researching and writing of this paper.

Secondly, the investigative and statistical background of Mr. Mike McQuilken, the MEDDAC's Internal Auditor provided a sound backstop against which I bounced numerous ideas and concepts. Both individuals aided in this project by taking the time to read through various drafts and making excellent suggestions which improved the content and flow of the final product.

Lastly, I want to thank my wife for her patience and moral support during those many and long evenings I was ensconced within our den. She learned, through my many mutterings, the truth to Murphy's maxim, "if something can go wrong, it will go wrong!"

Without their consistent support, both physical and moral, the timely submission of this project would not have been possible.

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I. INTRODUCTION

Materiel Management in the health care setting is the practice of providing various supply customers with the medical materiel they require to perform their treatment functions.[1] Determining whether an existing materiel management system is effective should be based on how well that system honors the five 'Rights of the Customer'. The customer, or end-item user, whether an individual or an organization, is entitled to the Right Item, in the Right Amount, at the Right Place, at the Right Time and for the Right Price. The manner in which a materiel distribution system supports or detracts from these Customer Rights plays a major role in determining that systems overall efficiency and effectiveness.[2]

In the specific case of a nursing ward in a hospital, these Rights can directly affect the quality of care received by the patient. An item required for treatment which is not available, or in the wrong quantity, or cannot be easily located, or requires the efforts of highly paid medical professionals to inventory and manage are all indications of a less than optimal medical materiel distribution system.

The cost savings to be obtained by the proper handling and distributing of medical supplies can be significant. Literature

has identified three basic methods of distributing medical supplies to the end-item user. These are the Cart Exchange System, a PAR Level System, and the Direct Requisition System. The experts in the field of hospital materiel management (John Housley, Dean Ammer, et. al), are unanimous in their opinion that the total Cart Exchange System is the most efficient at supporting the end-item user. However, there are different personnel, space and equipment requirements for each distribution system. Existing constraints make it necessary for each hospital to determine which system or combination of systems provides the optimum solution for their particular facility.

Conditions Which Prompted the Study

Munson Army Community Hospital (MACH) at Ft. Leavenworth, Kansas currently operates under a Direct Requisition System of medical supply distribution. This system has been identified by the Command Group as insufficient to adequately support the needs of the facility due to the excessive stockage levels found in all areas of the hospital. They have directed that a study be performed to determine whether a Cart Exchange System (CES) would be a feasible method of medical supply distribution at MACH.

Research Question

To determine whether the cart exchange system is a viable

method of medical supply distribution within Munson Army Community Hospital (MACH).

Objectives

1. To analyze the current medical supply distribution system at MACH.
2. To obtain information on materiel distribution systems (cart exchange and other) through a literature review and first-hand observation at military and civilian hospitals.
3. Compare and contrast current MACH distribution system with the cart exchange distribution model.
4. Determine whether the cart exchange model meets the materiel management needs of MACH.

Criteria

1. Implementation of a Cart Exchange System will require no additional personnel positions at MACH.
2. Projected available patient care time in the test area will increase by a minimum of 15%.
3. There will be a decrease in the dollar value of supplies stored in the test area of at least 25%.
4. All cost savings will offset the capital expenses of implementation within three (3) years (determined through cost/benefit analysis).
5. No policy or procedure recommended will violate current Army supply regulations or policies.

Assumptions

1. Information obtained from external sources about the advantages and disadvantages of various methods of medical materiel distribution will be applicable to MACH.
2. Necessary supply information on usage rates can be determined from existing supply management records.
3. Information on equipment, supply and manpower costs will be accurate enough to permit necessary evaluation and comparisons.

Limitations

1. An actual test of a Cart Exchange System cannot be performed at MACH due to current construction in-progress limiting required warehouse space and the non-availability of personnel and equipment to implement a full-scale test.
2. Lack of availability of adequate computer support will limit the sophistication of the statistical methods used. Trade-offs between test power and simplicity will be made in determining the statistical techniques used.
3. Supplies considered appropriate for this study will be limited to medical supplies issued from the medical materiel branch. No linen, administrative, CMS or pharmacy issued items will be included.
4. Estimated delivery times and storage requirements must be based upon the plans of the facility after completion of the renovation project.

METHODOLOGY

1. A Materiel Management Questionnaire has been developed. This questionnaire will be used to ascertain information as to current practices and problems with the existing material distribution system. It will be administered to all personnel assigned to all wards at MACH. This includes nursing and administrative personnel on all shifts. The survey questionnaire will be tested and modified based on comments received from both logistics and nursing personnel. The survey will be personally delivered to ward personnel on each shift and explained in sufficient detail to reduce inappropriate responses.

2. Time spent in supply functions by non-administrative ward personnel is considered to be time unavailable for direct patient care functions. All supply functions addressed (order, stock, pick-up, etc.) are considered within the job description and capabilities of a supply clerk/warehouseman (Military Occupational Specialty (MOS) 76J10/20 series or Civilian Personnell Office (CPO) equivalent). This supply time will be quantified by analyzing responses on the questionnaire and by observation. Time spent by all personnel on medical supply functions will be determined for all wards.

3. Chi-square tests for homogeneity (at the .05 level of significance) will be performed on the perception of supply outages. This will be done primarily to insure that the test ward is statistically similar to the rest of the wards. Also,

other information obtained from the questionnaire will be analyzed using non-parametric and non-statistical techniques to evaluate possible training or communication problems which were not due to the structure of the existing supply system. This information will assist in establishing a clearer picture of the current environment for discussion of the findings.

4. Under a revised supply distribution system, the ward staffs time spent on supply functions is considered to be available for non-supply functions (ie. patient care). Based on the responses of ward staff as to their alternate use of this time, a determination can be made as to the change in available patient care time (criteria #2).

5. On the test ward, all medical supplies obtained from Materiel Branch will be inventoried during a period selected to insure minimal stock usage . The total value of this inventory will be determined using current costs of replacement.

6. Information on the test ward's requisition pattern (item and quantity) will be obtained from the ward's requisition records. This data will provide an annual usage rate for each item and provide a basis for the development of a cart stockage level. Stock levels for a CES will be determined by test ward personnel and costed.

7. Inventoried levels will be compared to required stockage levels by coverting them both to days-of-supply. The difference between on-hand levels and a 15 day supply (based on quantity used per year divided by 26) will be considered excess inventory

and will be costed. This figure is the savings to be realized by a revised system (criteria #3).

8. Once estimated levels for the supply cart are established and costed, the size and number of carts will be determined based on current state of the art in cart design and actual operational cart systems. Dealer quotes will be used to develop procurement cost figures.

9. Time required to inventory and re-stock a cart will be obtained from a literature search and existing operating systems (ie. Ft. Hood) which utilizes an equivalent cart (in both size and number of items to be stocked). This information is available upon request.

10. Delivery times of carts will be ascertained by direct observation and timing of the movement of a facsimile cart to and from the proposed distribution location and the test ward.

11. Manpower costs based on the average wage per category of worker will be used to determine the personnel costs involved in medical supply functions and used in the concluding cost-benefit analysis. An example follows:

a. Various personnel state they spend a total of 2 hours per shift on supply functions. The time for each individual is annualized and costed based on an average wage for their job title. The total annual cost is determined.

b. The average annual time spent by personnel on all wards will be compared to the average time required by a supply warehouseman to perform the same tasks.

c. The cost difference is an indication of the relative efficiency of the respective methods of performing supply functions.

12. A cost-benefit analysis will be the final process of the study to determine whether a Cart Exchange System is feasible from a cost standpoint. Supply, personnel and equipment proposed costs under the CES will be compared with the current system (criteria #4).

13. Overall feasibility will be ascertained on how well the initially established criteria were met. An analysis of the findings will include discussion of other materiel handling methods (ie. PAR level system) which may achieve some benefits for other areas of the hospital or serve as an interim distribution system.

Literature Review

A review of the current and past literature in the area of hospital materiel management was performed. The vast majority of definitive writing appeared to be confined to two authors or their assosciates. These two individuals, John Housley and Dean Ammer, are the most prolific and noted authorities on nospital materiel management in the US. Both of these authorities wrote for non-military hospitals. Their philosophies on materiel management implied the direct hospital control over many of the inputs and systems which hospital commanders in the military health care system do not enjoy. The types of controls and

wide-range of procurement options referenced are not as easily adopted or implemented by the military hospital which must rely on an outside, non-medically oriented source for most procurement actions and a highly centralized medical supply depot system with a command directed supply inventory and accounting system. Also, the local commanders do not have the necessary control over personnel resources (either in number, grade distribution or organizational relationship) to effectively re-structure the organization into a more materiel management orientated design.

Accordingly, the comprehensive systems of materiel management proposed by the civilian experts in the field must be evaluated in this light to ascertain their potential for use in the Army hospital and particularily, Munson Army Community Hospital of Ft. Leavenworth, Kansas.

Rights of the Customer

"Getting the right supply to the right place at the right time in the right quantity is a tremendous task to perform even under the most ideal conditions."[3] In the same vein, Kowalski states that "The goal of any effective distribution system should be to provide the right item to the right place at the right time for the least total cost."[4] Combining these thoughts, the hospital materiel manager can envision the 5 Basic Rights of the Customer. Every customer of the hospital's Logistics Division is entitled to the:

Right Item: If non-sterile 2x2 gauze is required, then the

user doesn't have to use sterile 4x4s.

Right Amount: If the user needs 10 per week, then supply doesn't force him to order boxes of 100s.

Right Place: The items should be in the same location, readily available and in a usable form.

Right Time: The item should be available to the user when needed, on any shift, without having to locate a key or individual.

Right price: The item should be obtained at the lowest overall cost to the user (in procurement dollars, time, storage costs, etc.).

These Rights are all integrated and it is the role of the Materiel Manager or Logistics Officer to honor these Rights as completely as possible and communicate any shortfalls with the consumer.

Materiel Distribution Systems

"A distribution system is an integral part of a materiel management program and can significantly affect the performance of that program. Hospitals should keep in mind when evaluating their distribution system that there is no one best system for all situations (and hospitals)." [5]

Hospital materiel managers have five different methods of medical supply distribution at their disposal. These are: direct requisition, fetch and carry, PAR level, exchange cart, and stockless inventory programs. PAR level and Exchange cart

are variations of the same procedure as are direct requisition and fetch and carry.[6] Therefore, there are only 3 basic distribution methods which can be combined in many different ways.

The literature is replete with definitions of these different distribution methods. A brief discussion of each is necessary with particular focus on the role of the materiel manager and the user and which are recommended for various circumstances.

Direct Requisition and Fetch and Carry:

This is the oldest method of distribution used in hospitals. It consists of the user determining what is required, the preparing of a requisition for the items, the transmittal of the request to the main storeroom, and finally, the item(s) are delivered and charged to the requestor.

The difference between this method and Fetch and Carry method is in the delivery of the supplies to the user. The logistics personnel deliver to the using activity in the Direct Requisition method while the user must go to the supply area and pick-up his own supplies under Fetch and Carry. In both, the user is responsible for insuring receipt of the proper quantity and type of items. Also, the user must stock the supplies in his supply area(s). Each department functions as its own materiels manager with minimum influence by supply personnel.[7]

Cart Exchange and PAR Level:

The Cart Exchange and the PAR Level Systems of materiel

distribution are also similar. In both cases, the stockage levels to be maintained on the ward are determined by the user, in conjuction with logistics personnel. Once appropriate levels of supplies are identified, it is the responsibility of the materiel management personnel to insure these levels are maintained. The user has no responsibility for ordering, stocking or inventorying supplies. His only input is to periodically review stockage levels with supply and notify supply of any unusual requirements. The method of maintaining stockage in the users area is the primary difference between the two systems. In PAR level, user storage areas are inventoried and shortages filled by logistics on a return trip or from a master re-supply cart or from central stores. In the Cart Exchange System, pre-determined days-of-supply (generally 1-3 days) are pre-positioned on an identical cart in the supply area and exchanged on a recurring basis. All inventorying and re-stocking is done in logistics and not in the users area.[8]

Stockless Purchasing:

The 'stockless purchasing' method of materiel distribution is primarily used when the vast majority of an item is used by one or two activities (ie. laboratory or Xray) and re-supply does not require any additional stockage of the item in central stores. In this system, the vendor will deliver the required quantity (determined by the user) as contracted on a routine order cycle. This may be daily, weekly, monthly or annually. The entire quantity is recieved by logistics and delivered

directly to the user who must stock and maintain the supplies. This is similar to Direct Requisition in that the user is his own materiel manager.[9]

Advantages and Disadvantages

Each of these distributions systems have their own set of advantages and disadvantages. In order to be able to determine which distribution system best fits the needs of a particular facility, it is necessary to be aware of the strengths and weaknesses of each.

Stockless purchasing as a means of supply distribution has advantages for some areas of the hospital. However, it is not designed for the small volume use of multiple items of supply by numerous different activities. The disadvantages from a ward's point of view include:

1. high ward storeroom requirements.

2. receipt, inventory, control, quality assurance, etc. by ward (non-supply) personnel.

3. little control over ability to change requirements in the short term.

For these reasons, stockless purchasing is not a viable alternative for supply distribution to a hospital ward. For other areas of the hospital, like the laboratory or the pharmacy, this may be an acceptable alternative to maintaining stock at two locations within the facility (central stores and

the pharmacy or lab).

The Direct Requisition or Fetch and Carry Method have both significant advantages and disadvantages as means of providing supply support to a hospital ward. The advantages of this historically used system include:

1. low capital expenses needed to change the existing storage space or delivery equipment.

2. high acceptance by the user who feels they have 'control' over their supplies.

3. few organizational changes required due to the fact that this is a traditional and existing system.[10]

Significant disadvantages when compared to the other two systems include:

1. use of non-supply personnel (ie. nursing staff) to perform supply functions.

2. increased levels of inventory of supplies on the wards. This leads to pilferage, damage and outdated supplies. Management's control over the supplies is poor.

3. large supply storage spaces required throughout the hospital (central stores and the wards).

A PAR level or Cart Exchange System also have their own set of advantages and disadvantages. The major advantages to these systems are:

1. their ability to reduce the cost of inventory of supplies

within the user area.

2. the general reduction of storage space required in the patient care areas

3. the release of patient care providers from the responsibility for supply inventory, requisitioning, receipt and storage.

4. the increase in ability to provide good quality control of supplies

5. increases inventory turn-over per year.

The disadvantages to the systems, particularly the CES, are:

1. the capital expense costs of purchasing the necessary carts.

2. the personnel and organizational re-alignment required to establish and operate this system.

3. user reluctance to have their inventory 'controlled' by others.

4. increased traffic flow (of carts) between the distribution center and the users.[11]

"Although exchange cart systems are the answer to many hospital supply problems, they are not the panacea for all distribution without proper planning, study, and application."[12]

The PAR Level System shares much the same advantages and disadvantages with the CES system. There are several 'trade-offs'. Fewer carts are required (less capital expense) and there is less traffic between the distribution point and the

users. This is off-set by being more labor intensive (personnel costs) as supply personnel must inventory each ward storage area, pull required stock from the distribution warehouse and return to the ward with necessary stock to fill the storage areas to acceptable levels. Management control is less than with a CES because the user can draw-down stock while the re-stocking in being performed. The PAR level can be used to maintain ward inventory levels beyond what could be stored on a single supply cart.[13]

"The question of which procedure is best for any hospital is difficult to answer. The choice will depend on the nature of the physical plant and the economic impact of the financial resources required to establish and maintain a sound distribution program."[14]

Based on the results of a literature search, the following summary of comparisons of distribution systems is presented:

TABLE 1-1

Summary of Comparison of Options

	Direct Requisition	PAR Level	CES	Stockless Purchasing
Reduce Inventory	low	high	high	medium
Labor use	poor	fair	excellent	poor
Capital expenses	low	low	high	low
Space use	poor	good	good	poor
Control	poor	good	excellent	poor

SOURCE: James Kowalski, " Supply Distribution Options -- A New Perspective", HHMQ 2 (Nov 1980): p. 86, Table 1.

Before any decision can be rendered concerning the most appropriate materiel distribution system, the hospital's current procedure and effectiveness in providing the required support must be thoroughly understood and evaluated. The next section of this paper will discuss the existing system at Munson Army Community Hospital (MACH).

ENDNOTES

[1]John H. Holmgren and Walter J. Wentz, Material Management and Purchasing (Ann Arbor, MI: AUPHA Press, 1982), p. 167.

[2]Jamie C. Kowalski, "Supply Distribution Options--A New Perspective," Hospital Materiel Management Quarterly 2 (November 1980): p. 81.

[3]Charles E. Housley, Hospital Materiel Management (Germantown, MD: Aspen Systems Corp., 1978), p. 163.

[4]Kowalski, p. 81.

[5]Ibid., p. 82.

[6]Edward D. Sanderson, Hospital Purchasing and Inventory Management (Rockville, MD: Aspen Systems Corp., 1982), p. 212.

[7]Kowalski, p. 83.

[8]Housley, pp. 165-166.

[9]Sanderson, pp. 218-219.

[10]Kowalski, p. 9.

[11]James F. Coarse and Paul G. Pierpaoli, "An Exchange Cart Supply Distribution System Employed on an Institution-Wide Basis," Hospital Pharmacy 15 (August 1980): 400.

[12]James C. Richardson, "Exchange Carts Really Work," Hospital Materiel Management Quarterly 2 (November 1980): 13.

[13]Housley, p. 165.

[14]Sanderson, p. 219.

II. DISCUSSION

Existing Materiel Distribution System

Munson Army Community Hospital (MACH) is a 58-bed military hospital located at Ft. Leavenworth, Kansas. Medical supplies are distributed to the nursing units (wards and special care units) through the Direct Requisition distribution system. No Cart Exchange or Par-level stockage systems have ever been implemented at this facility for medical supply items.

MACH has four operating wards. These are: a twenty-four (24) bed medical/surgical ward; an eight (8) bed/eight (8) bassinett OB/Nursery ward; a twenty (20) bed Disciplinary Barracks ward; and a six (6) bed Special Care Unit (SCU).

Traditionally, the areas which can best benefit from a distribution system are those patient care areas where multiple users consume relatively small quantities of numerous supply items on a consistent and recurring basis. Usage rates are generally less than an entire case or box of supplies over the course of several days.

An understanding of the Army Logistics system is important in appreciating the challanges facing a military facility in the implementation of a Cart Exchange System or PAR Level System. The official accountability for all medical supplies is

maintained by the Medical Supply Officer and does not end until supplies are ordered and charged to the using activity though the Materiel Branch which is a stock-fund operation (funds used to buy supplies are used to replenish stocks). None of the items stocked in the Materiel Branch warehouse belong to the hospital. The computer program which operates this supply system does not have the capability of 'breaking' a unit of issue (U/I), (ie. box of 100 syringes) of an item into its smaller unit of measure (U/M), (ie. a syringe). Also, regulations currently prohibit the co-mingling of stock-fund and hospital owned supplies.

The MACH Logistics Division has established a two-week stockage level as the desired quantity of medical consummable supplies to be maintained on the ward. The exact quantity is to be on-hand if that amount can be ordered through the supply system. If the quantity of items in each case or box (the smallest unit which the existing supply system can issue to a customer) exceeds the two-week level then one case or box is authorized. Stockage levels are determined by the user. The facility recommends that semi-annual usage rates be determined from the user's requisition log and that the total quantity ordered be divided by 13. This number is the recommended stock level for each item. The re-order point is 1/2 of stock level.[1] Obviously, the stock level based on annual usage would be the total ordered divided by 26.

At present, the wardmasters of the inpatient areas are

responsible for the ordering, receipt, stockage, and inventory of all medical items in their areas of responsibility. The wardmasters and head nurses on the wards generally determine the items and levels to be maintained on-hand. Logistics personnel currently process the requisitions and deliver the required items to the ward in units-of-issue (U/I). Ward personnel must stock their own supply rooms and 'break' the boxes into usable quantities or units-of-measure (U/M). Because of the size of the boxes and cases which had to be ordered, all wards required two or three separate storage areas.

The system which the hospital Logistics Division recommends to the wards as the approved mechanism to control their ordering process is the 'living label' method. In their storage areas, a 3x5 card is to be physically placed after the last item which brings the total stocked quantity down to the reorder point. Periodically, the wardmaster should physically scan all the storage shelves, pull those cards he sees and orders those items. A walk-through of all supply areas of the hospital indicated that this method is not being utilized. Many areas had no stockage levels established, none had re-order points determined nor used the 'living label' method. All areas had an idea (a 'gut-feeling') of an appropriate stockage level for their activity but had no formal re-order points established. Evidence indicated that some items had not been ordered until they reached a zero balance, while others were ordered with several weeks worth of supplies on-hand.

The wardmasters' rational for the failure to follow established supply stockage and re-order policy was that insufficient time was available to manually determine stockage levels, usage rates or to establish valid stockage practices. In addition to medical supply activities, it is the responsibility of the wardmaster to manage all other logistics related matters. These include non-medical supply requests, all maintenance coordination (medical and non-medical), pharmacy and laboratory coordination, forms and office supply stocks, linen levels and property accountability.

A questionnaire was determined to be an effective instrument in obtaining a clearer picture of the interaction between the staff and the existing medical supply system.

Questionnaire

As stated in the Introduction, the purpose of any materiel distribution system is to provide the customer with what supplies they need to perform optimal patient care. If a supply system is not responsive in supporting the Rights of the Customer than the materiel manager must pinpoint the deficiency. To provide information from the customer (inpatient staff), a questionnaire was developed and distributed.

Methodology & Responses

The purpose of this questionnaire was to determine the perceptions of the ward staff as to the impact and implications

of the current medical supply system on the different wards.

Areas addressed in the questionnaire related to:

1. the perceived amount of time spent on their ward and shift in the performance of supply functions;

2. the various roles of ward personnel in the ordering, locating and retrieval of needed medical supplies;

3. the perceptions of experiencing 'outages' of necessary items and whether these items are normally stocked/available on the ward;

4. the types of items which are remembered as being unavailable for any reason;

5. those functions which ward personnel would perform if relieved of medical supply responsibilities.

Questionnaire Distribution/Collection

The questionnaire was developed in conjuction with senior nursing administrative staff and field tested among a select group before final corrections were made. The revised questionnaire (App. A) was then targeted to as many members of the inpatient nursing staff that could be reached during a 3 day period. Questionnaires were personally hand carried to the wards and explained to the head nurse on each ward, on each shift. Any questions were answered and the completed forms were picked up at the end of each shift. Of 66 personnel assigned to the wards, 53 usable responses were received. This was a return rate of 80%. "For an in-house questionnaire, a response rate of

between 50-75% is good."[2] Of those who did not respond, 8 were in schools of over 2 months duration and had no current official duties on any ward. The response rate is considered adequate for statistical analysis and to provide a base for valid assumptions concerning the status of the current supply system.

RESPONSE ANALYSIS

The following information is keyed to the corresponding Pie Charts in Appendix B. The information is taken from responses to various questions. A complete listing of all responses is found at Appendix C.

#1. 41% of the respondents were military or civilian registered nurses (RN). This chart reflects the job distribution of respondents. All personnel except wardmasters (selected 91Cs) and the ward clerks are involved in direct patient care as their primary duty.

#2. The highest density of staffing and of respondents came from the medical/surgical ward.

#3. Almost 87% of respondents identified that they personally have experienced a medical supply 'outage' on their ward at some time.

#4. 87% of respondents identified that these 'outages' occured less than one time per week (41% stated less than once per month). This indicates that outages were not very frequent but that when they occured they were remembered.

#5. 65% of respondents stated that their 'outages' were all items which are normally stocked on the ward. Due to the methods of inventorying observed on the wards (ie. lack of any type of reorder point), this is likely and very frustrating for the user. Another logical possibility is that the items were available at one of several other storage locations. Because of the lack of adequate centralized storage on each ward, an individual requiring an item may only look in the most logical location before seeking the item from another source or 'making do'.

#6. 67% of respondents indicated that the time they spent doing 'supply functions' adversely interfered with their provision of patient care 'Often' or 'Sometimes'. 32% felt that it 'Rarely' or 'Never' interfered with patient care. This question indicates that the supply functions currently being performed by nursing staff are perceived as impacting on patient care.

#7. 67% of respondents reported that if freed from their supply responsibilities, they would devote that time to the provision of patient care. This does not mean that there is an 'either/or' decision to be made. There is no indication that necessary patient care is not being provided due to supply functions. Discussions with personnel indicate that they would spend more time with the patients and provide additional care with any additional time. 13% would spend the time performing other non-supply administrative tasks. Using a Chi-Square 2x2

analysis (App. D), there is a significant difference (p=.0048) in the likelihood of a 'patient-care' response between 91Cs (all wardmasters and senior military NCOs on the wards) and ward clerks compared to other job categories (ie. military and civilian RNs and LPNs). This is an expected finding since ward clerks and a large proportion of 91Cs deal with the administrative aspects of the wards. The wardmasters, who are all 91Cs, have as one of their primary responsibilities all supply functions. This includes medical supply ordering, inventorying and stocking. They also are the interface with logistics division for all maintenance, property accountability and linen actions required by their ward. As Logistics Division is only open during the day-shift, only the wardmasters deal with 'official' supply functions. These individuals are not expected to perform primary nursing care except when personnel shortages or unexpected workload requires their assistance.

A wide variety of other information can be obtained from analyzing the responses to the questionnaire but these give a flavor for how the customer interacts with the supply system and how effectively it supports their needs.

What does this mean? In summary, the existing system is plagued by too many varied supply functions under the responsibility of a non-supply trained medical NCO. Support to the second and third shifts is left to medical personnel essentially untrained in supply functions. No adequate controls exist over stockage levels, re-order points or storage

procedures. Items are not easily located by the staff which must use them. Supply tasks are perceived as a burden by many patient care providers and time spent on supply functions is seen as adversely impacting on the provision of patient care. The customers (nursing staff) have identified problems with obtaining the Right Item, in the Right Quantities, at the Right Time and in the Right Place. If one considers the use of prime patient care time by registered nurses for supply functions cost-ineffective, then they are not getting the supplies for the Right Price either. The current supply system is neither as responsive nor responsible in meeting the needs of the customer as it should be.

INVENTORY ANALYSIS

Test Ward Selection

TABLE 2-1 .
WARD COMPARISONS
_1_ DECEMBER 1983 - 30_ NOVEMBER 1984

WARD	BED-DAYS	OCC.RATE	SUPPLY COSTS	% SUPPLY COST
MED/SURG	6025	67%	$20,304	25.7%
OB/NURS	2182	75%	$30,513	38.7%
SCU	1401	64%	$22,926	29.0%
DISC.BKS.	1013	19%	$5,128	6.6%

Selection of a test ward to perform an inventory analysis was performed on the basis of several criteria:

(1) supply records must be complete and legible enough to obtain a demand/usage history for a twelve month period;

(2) workload (bed-days) had to be such that supplies were in constant use throughout the period;

(3) Questionnaire responses must be obtained from a statistically significant proportion of the ward staff.

As depicted above, the med/surg ward had the highest number of bed-days during a 12 month period. Analysis of the occupancy rates of the wards during the past year revealed that the med/surg ward was 67%. More importantly, the average occupancy rate was relatively constant throughout the year, unlike the other wards which experienced significant peaks and valleys. The Questionnaire response rate from the med/surg ward was 90%, the highest of all wards (19 of 21 assigned personnel). A review of the requisition logs of all wards showed the med/surg ward to have consistent requisition patterns and legible entries throughout the year. An analysis of all wards' requisition patterns indicated the med/surg ward had used the least amount of 'year end' funds to purchase a stockpile of consumable medical supplies. For these reasons, the med/surg ward was selected as the test ward.

To determine whether this ward's supply system was considered as effective as the other wards by the staff, a Chi-Square analysis for homogeneity between the wards was performed. An appropriate measure to determine the effectiveness of the ward supply system, from the users' viewpoint, is the perception of supply outages. If all wards are the same in their reporting of outage frequencies, it can be assumed that all ward supply systems are of equivalent

effectiveness. The results obtained indicated there was no statistically significant reason to consider the wards different in their supply outage reporting frequencies (App. E) Therefore, the medical/surgical ward is a legitimate representative of all inpatient areas.

Usage Rates

An analysis was conducted of the requisition log (checkbook) of the test ward for the 12 month period Dec 83 - Nov 84. Each seperate request was identified as to stock number, nomenclature and quantity requested. All like items were then sorted and tallied. This resulted in a list of 170 different items which were ordered during the year. When specialty and non-medical items were purged from the list, 162 lines remained (App. F). Of these, 3 lines were discovered to have been erroneously ordered from supply instead of being requested through Pharmacy or CMS. The remaining 159 lines of supply were costed (based on a November 1984 price list) to determine actual supply costs for the year. The test ward spent $ 21,288.93 on consumable medical supplies during that 12 month period.

Monthly supply totals were compared with the corresponding number of bed days for the med/surg ward. This information was obtained from workload reports available from the Comptroller. A Theil test (a method for testing the hypothesis that the slope of the line is 0, indicating no correlation between bed days and supply costs), was performed on this data, as well as

on similar data for all wards at Munson and all wards on the CES at St. John's Hospital (App. G). If medical supplies were used and re-ordered based on actual patient requirements, then there should be an increase in supply costs as bed days increase (positive slope). However, when testing both Munson hospital and the test ward, the results were not significant at the a=.05 level. This was to be expected since the order patterns and stockage levels of supplies on hand seemed to have no bearing on the actual rate of usage of supplies.

St. John Hospital is a local not-for-profit hospital which is of similar size (in ward size and occupancy rates) and has a cart exchange system which includes the same type and quantity of items considered under a CES at MACH. The same Theil test was performed on the supply costs versus bed-days at St. Johns Hospital. Their data was significant at the a=.05 level.

Test Ward Inventory

A 100% inventory of all storage areas belonging to the medical/surgical ward was conducted on 25 January 1985 in conjunction with the wardmaster. Based on the master requisition list, exact counts, by Unit-of-Measure (U/M) were taken. These quantities were costed to determine inventory dollar value. The value of inventory on-hand totalled $ 9,102.14 (App. H). Based on an annual usage of $ 21,288.93, this indicated that inventory 'turned' 2.34 times per year, or there was the equivalent of 5.16 months of stock on the ward.

With a 2 week supply level authorized, it is expected that ward inventory should 'turn' approximately 26 times per year.

The ward's annual order quantities were divided by 26 and rounded to the next unit-of-measure to determine a two-week stockage level.

Inventory Level Comparisons

From the test ward data, it was determined that if 2 weeks of supplies, in units-of-measure, could be stocked either on carts or shelves, the value of this inventory would be $ 1,020.75. This would generate a reduction in the hospital's investment in supplies of $ 8,081.39.

Were currently established Direct Requisition stockage and re-order policies on days-of-supply being followed, even considering the nesessity for ordering a full box or case of each item, the amount of savings in supplies on-hand over current ward inventory would total $ 5,289.19. This is based on the total value of two weeks usage (rounded to the next higher Unit-of-Issue) costing $3,812.96.

Materiel management principles state that inventory should be relatively stable at any given point in the year when re-order points are established and monitored (ie. through the use of a 'living-label' method). This is a valid and necessary assumption since there is no way to determine the beginning inventory levels of the ward 12 months previous. In order to reduce the possible effects of either hoarding, (due to the

traditional fiscal year-end (Aug-Sep) surplus of funds) or supply shortages (due to 3rd & 4th quarter fund constraints), January was determined to be the best time to conduct an inventory. Any surplus supplies would have been consumed during the first quarter of the fiscal year and year end supply dollar constraints (generally beginning in 3rd quarter) would not have had to be placed in effect.

Were a PAR Level or CES to be implemented which would be based on stocking a one, two or three day supply on the ward, a total of 2 weeks worth of supplies would be hospital-owned and all items not maintained on the ward would be maintained in the Materiel Distribution Warehouse. Under the current system, each ward would have the equivalent of this same 2 weeks supply in their storage rooms. The same quantity of Units-of-Issue in a central area would greatly reduce the overall ward requirements for storage space and total inventory costs. There is as high as a 50% potential for total hospital inventory reduction of supply items placed under a PAR level or Exchange Cart System over the Direct Requisition method.[3] Based on the above information, the test ward's inventory reduction potential, if a CES is implemented, would be 88%.

It is readily appearant that the Direct Requisition method of stockage, with its focus on case-lots (units-of-issue) results in the stocking of an excessive quantity of some medical supplies on the ward. In order to reduce this over-stockage situation, it would be necessary to establish and staff a

separate, hospital-owned breakdown area (Materiel Distribution Warehouse) where appropriate quantities of supplies can be assembled for issue to wards either in a PAR Level or Cart Exchange System.

CAPITAL EXPENSE ITEMS

In order to implement a CES, equipment for three functions will be required:

1. supply distribution to the wards
2. supply storage in the Materiel Distribution Warehouse
3. inventory control/costing procedures

These can be fulfilled through the procurement of supply carts, shelving and a micro-computer system.

Supply Carts

There are several manufacturers of supply carts which are suitable for use in an exchange cart system. Two hospitals in the immediate area of Ft. Leavenworth which have cart exchange systems (CES) utilize similar carts. Observations were made of the number of lines to be stocked and the size of the supported wards at these hospitals. The cart system in use at St. Johns Hospital, Leavenworth Kansas was seen as the type most closely fulfilling the cart size and space needs of MACH.

A description of the cart size and type are attached at Appendix I. The main issue in the selection of a cart system is the total capital expense required in obtaining the necessary

number of carts to support the facility. "A cart must have the capacity to hold approximately 200 different items and more than 1,000 items in total."[4] The test ward will have a need to stock 159 lines. The carts in use at the Veterans Administration Medical Center and St. Johns both hold within the recommended quantities of medical supplies.

Storage space currently available on all the wards for the storage of necessary medical consumable items is sufficient to handle either a Par Level or a Cart Exchange System. The configuration of the supply areas will vary depending on the type of system implemented. Total space requirements will be less than under the current Direct Requisition system due to the change from stockage of Units-of-Issue (U/I) to Units-of-Measure (U/M).

Two carts would be required for the establishment of a CES on the medical/surgical ward for medical consumable items. At current prices and with necessary accessories (ie. drawers, partitions, cart cover, ect.) these carts will have a one-time cost of $ 2,750. Expanding this system to all four inpatient wards would require a total capital expense of $ 11,000. The carts have a life-expectancy of at least five (5) years and with minimal replacement parts and maintenance have exceeded eight (8) years (per discussion with Mr. Lund, Director, Materiel Management, St. John Hospital). $200 per year should be programmed for supplies, parts, etc.

Shelving Units

Under either PAR Level or CES, an additional expense for shelving for the Materiel Distribution Warehouse must be considered. In order to 'break-down' approximately 300 lines of U/I into U/M, additional shelving units costing approximately $ 2,500 will be required. No recurring expenses should be generated. Although the test ward only required 159 lines, the expansion to other areas (ie. OB, SCU, ect.) would increase the number of different lines required for ward distribution.

Computer Support

Both the VA Medical Center and St. John have computers to manage the inventory levels and stock lists for their CES. This is necessitated by the requirement to properly cost the using activity with the value of the quantities consumed. A basic computer (IBM PC or equivalent w/monitor and printer) with off-the-shelf software package can be obtained for $5,000 with annual supply/maintenance costs of $300. No existing computer support in the hospital can be used for this purpose. The Army has an approved automation program for this purpose which integrates with standard Health Serice Command supply systems.

This brings the requirement for one-time capital expense equipment to $ 18,500 and annual supply costs to $500.

Under the existing distribution system, there are no current equipment/maintenance costs would be avoided (saved) if another system is implemented.

PERSONNEL UTILIZATION

Personnel Costs

The average pay grade of government employee (military and civilian) at MACH was used to establish a base pay comparison between different positions. Base military pay was also used in accordance with current Civilian Personnel and comptroller cost comparison practices. Because the computed rates for military and civilian Registered Nurses was within ten cents per hour, a single wage for all RNs was determined to be $12.39 per hour.

Formulas to determine annual rates did not take into account seasonal variations, potential leaves or sick days. Evaluation of the ward procedures indicated that the supply duties identified by any particular care provider were consistent throughout that ward and similar duties would be normally performed by others of the same grade (ie. specific supply tasks would be performed by whichever LPN was assigned on that shift).

Because of the wide range of time responses from all staff, exact times spent in supply functions by each position were extremely hard to verify. Therefore, the reported times were used as being accurate.

Times reported by each questionnaire respondent were annualized and costed at the base pay of the individual's position. These costs were totalled to determine an annual cost for ward personnel to perform medical supply functions. Time

reported was annualized to 4919.5 hours. This equates to 2.36 FTE (full-time equivalents). At the current pay scales (Dec. 84), total salaries paid to ward personnel to perform medical supply functions were $ 36,657.74.

Staffing Alternatives

In order to transfer these supply functions from nursing to logistics, it is necessary to determine what job series, grade level and salary would be required for supply personnel. An analysis of the appropriate Civil Service job descriptions indicates that two positions (a supply clerk, GS-3) and/or a warehouseman (WG-4) could perform these tasks. However, in order to perform necessary warehousing functions, at least one warehouseman would be required. Nursing's $ 35,657.74 in 'supply' payroll would provides funding for:

a. 1.6 FTE in warehousemen, or

b. 2.9 FTE in supply clerks, or

c. 1 FTE supply clerk and 1 FTE warehouseman

+ savings of approximately $ 2,000.

Given that no additional personnel authorizations will be obtained by the hospital to support any distribution system, nursing must transfer the equivalent of 2 FTEs from the wards to logistics in order to perform these functions. Option c above provides the most flexibility to logistics and best coverage for the wards.

Due to the economies of scale to be obtained by a

centralized distribution system for common-use items. 2 FTEs of trained supply personnel will be able to perform the essential functions of 2.36 FTEs of semi-trained ward personnel in addition to operating the Materiel Distribution Warehouse. This information is visually depicted in Appendix J. The main concern would be the selection of nursing slots which would be 'moved' to logistics. Since patient care is provided by all ward personnel except the ward clerks and some wardmasters, and the clerks currently perform minimal supply functions, serious consideration must be given in this selection. Further complicating this situation is the fact that nursing's Central Materiel Supply (CMS) is not involved in distributing expendable medical supplies of any kind and is minimally staffed for sterile pack preparation only.

Time Trade-Offs

The actual time savings to ward supply personnel must be evaluated in light of the time currently required to perform medical supply order/delivery and stockage functions.

Deliveries of medical supplies to the test ward require an average of 20 minutes to complete. In the past year, it was estimated that 150 trips were made to the test ward. This correlates to 50 hours per year in transport time. It includes travel time to and from the ward and the time required to locate the wardmaster and have him inventory and sign for received supplies. It does not include trips for emergency items or repeat trips because the wardmaster was not available when

supply reached the ward.

Exchanging a supply cart with the ward required an average of 12 minutes to complete and would not require any interaction with ward personnel. This would be performed one a day, 261 days per year (or 52.2 delivery hours). Delivery times would remain relatively unchanged in any distribution system. Logistics personnel would still perform all deliveries. The benefit is that ward involvement would be greatly reduced under a PAR level or CES system.

Based on interviews with the Materiel Managers at the VA Medical Center and St. Johns Hospital. It was estimated that cart inventory and re-filling times ranged between 30 and 50 minutes per cart, depending on total number of lines and degree of cart depletion. "Time and motion studies of the assembly line show that on an average, it takes 40 minutes to fully process a depleted cart".[5]

Under the Direct Requisition system, someone on the ward must perform a periodic inventory of items to determine which items and quantities to be ordered. An analysis of questionnaire responses of senior nursing NCOs (91Cs) indicates that they spend approximatiely 60-90 minutes per day inventorying, breaking-down, or stocking supplies. Since this function is performed by supply personnel under a CES, the ward time is directly transferable to logistics. Between 20 and 50 minutes per day for each wardmaster would be saved by the adoption of a CES. These savings do not include the amount of

Cost Benefit Analysis

A Cost Benefit Analysis of three options for possible medical materiel distribution systems was performed. The existing system of Direct Requisition is compared with a Direct Requisition system which enforces current supply policies and with a Cart Exchange System. The results of this CBA are depicted below:

TABLE 2-2.

COST ANALYSIS -TEST WARD

		CURRENT PRACTICE	ENFORCED PROBABLE	CART EXCHANGE
YEAR 1				
INVENTORY		9102.00	5000.00	3813.00
PERSONNEL		13563.46	13563.46	13043.46
EQUIPMENT		0.00	0.00	3375.00
TOTAL		22665.46	18563.46	20231.46
YEAR 2				
INVENTORY	6.00%	9648.12	5300.00	4041.78
PERSONNEL	8.00%	14648.54	14648.54	14086.94
EQUIPMENT		0.00	0.00	125.00
TOTAL		24296.66	19948.54	18253.72
2YR SUBTOTAL		46962.12	38512.00	38485.18
YEAR 3				
INVENTORY	6.00%	10227.01	5618.00	4284.29
PERSONNEL	6.00%	15527.45	15527.45	14932.15
EQUIPMENT		0.00	0.00	125.00
TOTAL		25754.46	21145.45	19341.44
3 YR TOTAL $		$72,716.57	$59,657.45	$57,826.62

Inventory cost figures are those computed as being 'hospital-owned' for the medical/surgical ward. Under current practice $8102 in inventory is on-hand. Under an enforced Direct Requisition policy, inventory costs for two (2) weeks supply (using U/1), would be $3813. With the establishment of a Materiel Distribution Warehouse, exchange cart inventory would vary depending on number of days supply to be stocked on each cart but a total of 2 weeks stock (on carts and in the MDW) should cost $3813 for the test ward. It is unreasonable to assume a completely effective Direct Requisition system can be accomplished. With maximum nursing staff supply training and supervisor support, logistics and nursing personnel estimate that average inventory on the test ward would not fall below $5,000. This figure would result in a break-even for a CES slightly before the end of the three year time-frame.

Capital expense equipment and recurring maintenance costs would be shared proportionately among the four wards which would be supported by the MDW based on share of supply dollars spent annually. The test ward spent 26% of inpatient medical supply dollars for the year.

Personnel costs are considered for the ward as a whole. Because the four wards could each 'donate' .5 FTEs, but the salaries are not saved by the hospital (they are transfered to logistics), only the difference in annual salaries ($2000) would be 'saved' by the ward. A distribution based on the ward's share of supply costs (26%) was also used here.

The results of this cost benefit analysis of the three options show that implementing a CES directly from the existing system would pay for itself within the first year of implementation/conversion.

ENDNOTES

[1]Logistics SOP#6, Medical Materiel Branch, Munson Army Community Hospital, 28 December 1982.

[2]"What The Hospital Staff Could Tell You About Your Performance--If You Asked," Hospital Materiels Cost Containment Newsletter, Vol. #6 (June 1983): 4.

[3]Jamie C. Kowalski, "Supply Distribution Options--A New Perspective," Hospital Materiel Management Quarterly 2 (November 1980), p. 86.

[4]Charles E. Housley, Hospital Materiel Management (Germantown, MD.: Aspen Systems Corp., 1978) p. 167.

[5]Ibid., p. 174.

III. CONCLUSION

FINDINGS VS. CRITERIA

The question to be answered is whether the cart exchange system is a viable method of medical supply distribution within Munson Army Community Hospital. The comparisons of the current system and other methods of distribution have been made. The advantages and disadvantages of all have been evaluated in light of the hospital's existing environment. Now is the time to determine whether the original criteria have been met.

1. Implementation of a Cart Exchange System will require no additonal personnel positions at MACH.

Based on reported nursing staff involvement in the existing system, and the projected manhours and personnel requirements for operatin a CES, no additional personnel positions will be required. However, two personnel authorizaions must be transfered from nursing to logistics. Criteria #1 has been met.

2. Projected available patient care time in the test area will increase by a minimum of 15%.

The total time spent by nursing staff on medical supply activities was reported as being 4923 hours per year. Those individuals who claimed they would spend any of this supply time performing patient care functions totalled 2870 hours per year.

This was a net increase of 58% in available patient care time realized. Criteria #2 has been met.

3. There will be a decrease in the dollar value of supplies stored in the test area of at least 25%.

Under a CES, the value of ward inventory would be reduced from $9102 (actual) to $1021 (on test ward), an 88% decrease. There is no reason to expect any differences in the other wards. Even when assuming that the wards had valid two week stockage levels in U/I on-hand, the total ward inventory value would be reduced from $3813 to $1021, a 73% decrease. Criteria # 3 has been met.

4. All cost savings will offset the capital expenses of implementation within three (3) years (determined through cost/benefit analysis).

The results of the Cost Analysis indicates that cost savings in a CES would offset the capital expenses of implementation within one (1) year. Criteria #4 has been met.

5. No policy or procedure recommended will violate current Army supply regulations or policies.

Constraints on job series and pay, procurement policies and stock-fund requirements have all been taken into consideration in evaluating the alternatives available. No existing supply regulations or policies from any higher headquarters will be violated. Hospital policies must be re-written to properly reflect necessary procedures. Criteria #5 has been met.

All criteria having been successfully met or exceeded, it is

reasonable to state that the Cart Exchange System would be viable as a method of medical supply distribution within Munson Army Community Hospital.

Recommendations

Because the CES would be a viable system to implement does not necessarily mean it is the best system. "Although exchange cart systems are the answer to many hospital supply problems, they are not the panacea for all distribution without proper planning, study, and application."[1]

There are two major obstacles which must be overcome before a CES can be implemented at MACH. The first deals with space. In order to establish either a Cart Exchange or a Par Level system, a Materiel Distribution Warehouse area must be established. Based on other hospitals' experiences, an area of approximately 500 square feet is required. This area must be located where distribution costs of the carts will not exceed potential savings. At present, there is no area within MACH to establish this facility.

The second major obstacle is the release of personnel authorizations from the Department of Nursing to Logistics Division. Although patient care time would be freed on the ward areas, the reduction of two positions in patient care areas would have an adverse impact on the staffing and functioning of those wards. Wardmasters would be able to spend more time in patient care which would help offset the short-staffing. The

nursing positions could be taken from the more administratively orientated areas of nursing (ie. ambulatory nursing or nursing education). However, the dollars to be used to pay salaries for the supply personnel will not be available if the shifted positions are of the lowest salaried nursing employees. Trade-offs could be made as to the mix of staffing to support the MDW. If ward staff performed their own cart exchange and supply staffing were modified to reduce total payroll costs, then a part-time individual could be funded for nursing. Re-structuring of logistics to combine all delivery functions (including linen), the expansion of the CES to include more areas than inpatient wards (ie. clinics) may improve the economies of scale such that greater overall savings may be realized. The main point of these observations is that many alternatives are possible once a commitment is made to implement a CES. This commitment is only the first of a long series of hard decisions which must be made by both administrative and nursing staff before all the benefits of the CES can be realized. Due to equipment funding and procurement lead-time, a CES could not be fully implemented for 12-18 months from the date of local approval. Programming of the equipment can begin and existing Direct Requisition procedure can be enforced. Another inventory analysis of the test ward can be performed in 6 months to determine any significant changes in the current situation and whether the conclusions of this study would be changed.

When conducting a final analysis, "hospitals should remember to take a broad systems approach...A hospital's distribution system is an intricate network from storage to user points."[2] . The implementation of a carefully planned Cart Exchange System should provide the end-item user far more efficient service then the present system. The implementation of the CES can result in better support to the customer and the ultimate benefit will be more effective and efficient patient care.

ENDNOTES

[1]James C. Richardson, "Exchange Carts Really Work," Hospital Materiel Management Quarterly 2 (November 1980): 13.

[2]Jamie C. Kowalski,"Supply Distribution Options--A New Persoective," Hospital Materiel Management Quarterly 2 (November 1980): 86.

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APPENDIX A

QUESTIONNAIRE

INSTRUCTIONS
MATERIEL MANAGEMENT QUESTIONNAIRE

The purpose of this questionnaire is to determine the extent of involvement by nursing personnel in the management of medical supplies which are ordered or received through Materiel Branch, Logistics Division. CMS, Self-Service and Pharmacy items are NOT part of this study.

Questions should be answered by each individual seperately. No names are required; however, the shift and ward you are answering the questions about must be identified. If you have recently changed wards or shifts, identify the ward and shift which is applicable for your responses.

Some of the questions will permit more than one answer, others require a single answer. If there is a question as to the most appropriate response, use the one you feel is most common or the biggest problem.

Please fill out the questionnaire during the shift in which you receive it and return it to the Head Nurse or Nursing Supervisor for pick-up the following day.

Questions may be addressed to MAJ D'Agostino, Administrative Resident, MAJ Levinson, Asst. C, Nurse or your Nursing Supervisor.

Your cooperation is greatly appreciated. Thank you for your time and responses.

Michael D'Agostino
MAJ, MSC
Admin. Resident

MATERIEL MANAGEMENT QUESTIONNAIRE

WARD _____ SHIFT_____

JOB DESCRIPTION (circle one):

RN LPN 91C 91B Nsg Asst. Ward Clerk OTHER _____

1. Have you ever run out of a needed <u>medical supply</u> item on your shift?

YES ____ NO ____ (if NO, answer 5 & 7-10)

if YES, what type of item(s) were they?

_____
_____

2. When a medical supply item is not available, what have you done (select one or more).

___ Borrow from another ward.

___ Contact Logistics Division

___ Make-do without the item

___ Contact my supervisor

___ (Other) _____

3. How many of these unavailable items are normally stocked on your ward?

ALL ___ SOME ___ NONE ___ UNKNOWN _____

if any are stocked, where are they normally kept? (one or more)

___ Nurses station

___ Main ward supply area

___ Patient room

___ other _____

___ unknown

4. How often have you been unable to locate a stocked medical supply item you needed? (select one)

___ less than once per month

___ Less than once per week

___ 1 or 2 times per week

___ 3 or more times per week

5. Who is responsible for determining what supplies will be stocked on your ward? (select one)

___ Head nurse, day shift

___ Wardmaster

___ Do not know

___ Logistics division

___ Other _____

6. When an item is not immediately available on the ward, who: (select one for each column)

LOCATES	OBTAINS	items needed?
___	____	RN/LPN
___	____	91C (NCOIC)
___	____	91B/Nsg Asst.
___	____	Clerk
___	____	Logistics personnel
___	____	Other non-ward personnel (ie. NCOD)

7. How much time (in minutes) do you spend performing any medical supply related function (ie. order, pick up, inventory, of non-pharmacy medical supplies?)

_____ minutes per SHIFT / WEEK (circle one).

8. In your opinion, how often does medical supply business interfere with your delivery of direct patient care?(circle one):

Always Often Sometimes Rarely Never

9. If I did not have to spend time doing medical supply functions ,I would use the time to perform: (mark ONE)

___ other supply functions (ie. coordination for linen, medical or non-medical maintenance, hand receipts, MEDCASE, etc.)

___ administrative functions (reports, scheduling, supervision etc.)

___ direct patient care (treatment, education, services)

___ training or training management (of other providers or self; ie. in-service trng.)

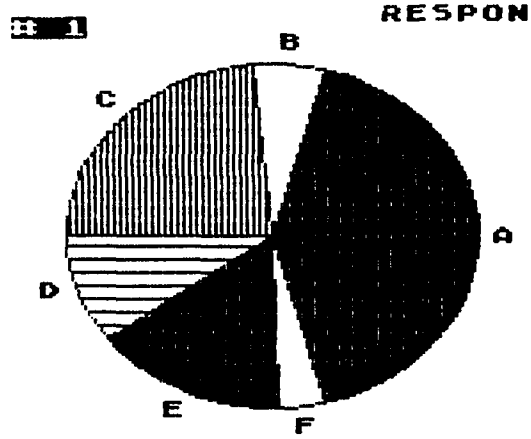
___ other _____.

10. What changes would you like to see in the supply system which would make your job easier? (please write legibly and make any constructive comments you desire).

APPENDIX B

QUESTIONNAIRE PIE CHARTS

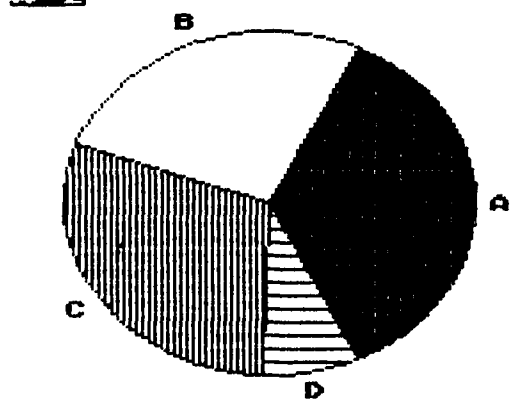
RESPONSES



POSITION	PERCENT
A:RN	41.51
B:LPN	5.66
C:91C	22.64
D:91B	11.32
E:NSG ASST	15.09
F:CLERK	3.77

SUPPLY QUESTIONNAIRE

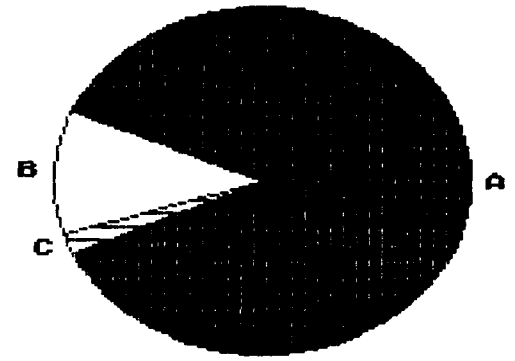
RESPONSES BY WARD



WARD	PERCENT
A:MED SURG	35.85
B:OB/NURS	26.42
C:SCU	30.19
D:DB	7.55

SUPPLY QUESTIONNAIRE

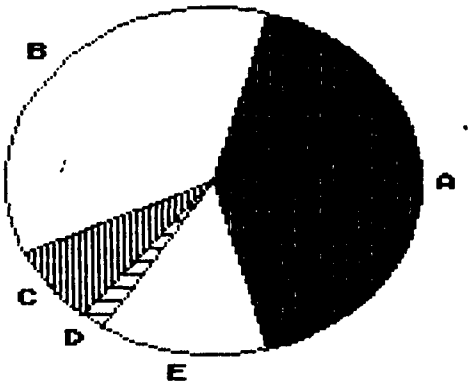
SUPPLY OUTAGES



RESPONSE	PERCENT
A:YES	86.79
B:NO	11.32
C:NO RESP	1.89

SUPPLY QUESTIONNAIRE

FREQUENCY OF OUTAGE

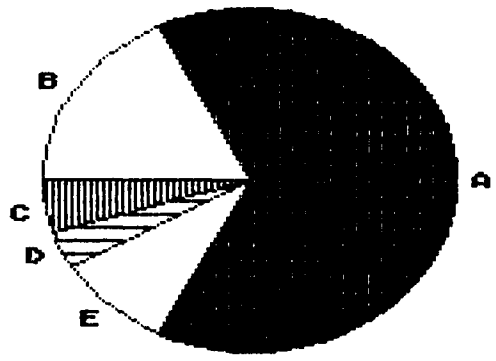


OUTAGE	PERCENT
A:<1/MONTH	41.51
B:<1/WEEK	35.85
C:1-2/WEEK	7.55
D:3+/WEEK	1.89
E:NO RESP	13.21

SUPPLY QUESTIONNAIRE

5

SHORT ITEMS STOCKED

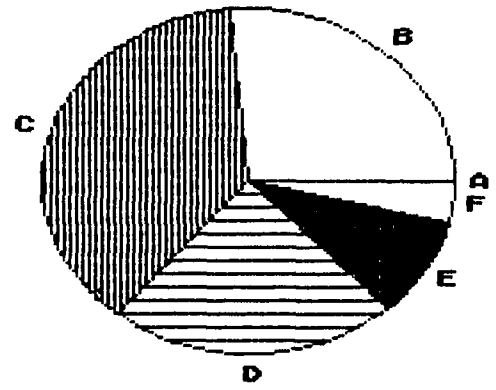


STOCKAGE	PERCENT
A:ALL	64.81
B:SOME	18.52
C:NONE	4.70
D:?	4.70
E:NO RESP	9.26

SUPPLY QUESTIONNAIRE

6

DELAY PATIENT CARE?

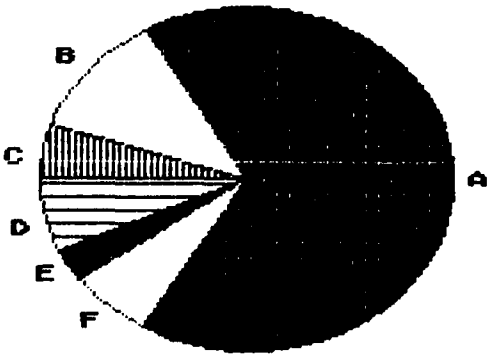


INTERFER	PERCENT
A:ALWAYS	0.00
B:OFTEN	26.42
C:SOMETIME	37.74
D:RARELY	22.64
E:NEVER	9.43
F:NO RESP	3.77

SUPPLY QUESTIONNAIRE

7

WITH SUPPLY TIME I'D



RESPONSE	PERCENT
A:PAT.CARE	66.67
B:ADMIN	11.67
C:TRAIN	6.67
D:SUPPLY	5.00
E:OTHER	3.33
F:NO RESP	6.67

SUPPLY QUESTIONNAIRE

APPENDIX C

QUESTIONNAIRE WARD RESPONSES

MEDICAL/SURGICAL WARD QUESTIONNAIRE RESPONSES

RESP #	SHIFT	JOB	OUT?	WHAT DO?	STOCKED?	WHERE STORED	FREQUENCY OF OUTAGE	DETERMINES STOCK LVL	WITH A SHORTAGE, WHO FINDS	WHO GETS
29	1	91B	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	RN/LPN	RN/LPN
35	1	91B	NO	BORROW	SOME	MAIN WARD SUPPLY	1-2/WEEK	HN	RN/LPN	91B/ASST
19	3	91B	YES	BORROW	SOME	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	RN/LPN	91C/NCOIC
34	1	91C	YES	BORROW	ALL	MAIN WARD SUPPLY	1-2/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
17	2	91C	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
36	1	ASST	YES	BORROW	ALL	OTHER	<1/WEEK	WARDMASTER	91B/ASST	91B/ASST
41	1	ASST	YES	BORROW	?	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	91C/NCOIC	91C/NCOIC
15	2	ASST	YES	BORROW	ALL	MAIN WARD SUPPLY	>3/WEEK	WARDMASTER	91B/ASST	91B/ASST
21	5	ASST	YES	BORROW	ALL	MAIN WARD SUPPLY	NR	NR	NR	NR
40	5	ASST	YES	BORROW	SOME	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
37	1	RN	YES	BORROW	SOME	OTHER	<1/WEEK	HN	RN/LPN	91C/NCOIC
39	1	RN	YES	BORROW	ALL	UNKNOWN	NR	WARDMASTER	RN/LPN	RN/LPN
43	1	RN	YES	BORROW	SOME	NURSE STATION	<1/MONTH	WARDMASTER	RN/LPN	RN/LPN
3	2	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
16	2	RN	YES	BORROW	ALL	OTHER	<1/WEEK	WARDMASTER	RN/LPN	91C/NCOIC
18	2	RN	YES	BORROW	ALL	OTHER	<1/MONTH	WARDMASTER	RN/LPN	91C/NCOIC
20	5	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	HN	RN/LPN	91C/NCOIC
38	5	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	HN	RN/LPN	91C/NCOIC
42	5	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	91C/NCOIC	91B/ASST

RESP #	SUPPLY TIME MIN.	PER	DOES IT INTERFER	IF NOT SUPPLY, WOULD RATHER DO	IF I COULD BE IN CHARGE COMMENTS	ITEMS MISSING AT TIMES
29	8	WEEK	RARELY	PATIENT CARE	REDUCE WASTE ON WARD	CUPS, PITCHERS, URINALS
35	0	NR	NEVER	PATIENT CARE		NA
19	120	SHIFT	SOMETIMES	PATIENT CARE	NIGHT SHIFT INV/ORDERS!	PAPERWORK (FORMS),LINEN
34	240	SHIFT	SOMETIMES	SUPPLY	NONE	IV TUBING
17	0	NR	SOMETIMES	PATIENT CARE		NO RESPONSE
36	0	NR	SOMETIMES	PATIENT CARE	QUALITY OVER COST -H20 PITCHER	COTTON APPLICATORS, PAPER CUPS
41	3	WEEK	NEVER	PATIENT CARE		URINAL, BEDPAN, NEBULIZERS
15	15	SHIFT	OFTEN	PATIENT CARE	HAVE SUPPLIES ON-HAND	4X4,CHUCKS,KERLIX,DIAPERS,ETC
21	0	NR	SOMETIMES	PATIENT CARE	WASTE BY WARD MAIN PROBLEM	KERLEX,CATH TIP SYRINGES
40	10	SHIFT	SOMETIMES	PATIENT CARE		PITCHERS, SOAP, RT EQUIP
37	30	WEEK	SOMETIMES	PATIENT CARE	NO COMMENTS	IV TUBING, PAPER CUPS
39	0	NR	RARELY	NR	NO COMMENTS	IV TUBING, MASKING TAPE, LINEN
43	0	SHIFT	SOMETIMES	PATIENT CARE	NO COMMENTS	IV TUBING
3	0	NR	SOMETIMES	PATIENT CARE		NON STER GLOVES,ALCOHOL SPONG.
16	30	WEEK	SOMETIMES	PATIENT CARE	MORE STORAGE-ALPHABETICAL STOR	DIAPERS,FORMULA,RESP.EQUIP
18	120	WEEK	OFTEN	PATIENT CARE		IV TUBING,KERLIX,DIAPERS
20	0	NR	RARELY	PATIENT CARE	NONE	NO RESPONSE
38	15	NR	SOMETIMES	ADMIN	NONE	LINEN, IV SUPPLIES
42	30	SHIFT	OFTEN	ADMIN		VARIOUS ITEMS

OB/NURSERY WARD QUESTIONNAIRE RESPONSES

RESP #	SHIFT	JOB	OUT?	WHAT DO?	STOCK?	WHERE STORED	FREQUENCY OF OUTAGE	DETERMINES STOCK LVL	WITH A SHORTAGE, WHO FINDS	WHO GETS
46	1	RN	NO	BORROW	NONE	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	RN/LPN	RN/LPN
32	5	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	HN	RN/LPN	91B/ASST
22	3	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	HN	91C/NCOIC	91C/NCOIC
9	5	RN	YES	BORROW	ALL	NURSE STATION	<1/MONTH	HN	RN/LPN	RN/LPN
30	1	LPN	NO	BORROW	NR	MAIN WARD SUPPLY	NR	WARDMASTER	RN/LPN	RN/LPN
11	2	LPN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	HN	RN/LPN	RN/LPN
47	5	91C	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	HN	91C/NCOIC	91C/NCOIC
45	1	91C	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	91C/NCOIC	91C/NCOIC
26	1	91C	NO	NR	NR	NR	NR	WARDMASTER	NR	NR
23	3	91C	YES	BORROW	ALL	NURSE STATION	<1/WEEK	WARDMASTER	RN/LPN	RN/LPN
52	5	91B	YES	BORROW	ALL	OTHER	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
10	2	91B	YES	MAKE-DO	ALL	OTHER	<1/MONTH	DON'T KNOW	RN/LPN	RN/LPN
44	1	CLERK	YES	BOSS	ALL	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	91C/NCOIC	CLERK

RESP #	SUPPLY TIME MIN.	PER	DOES IT INTERFER	IF NOT SUPPLY, WOULD RATHER D	IF I COULD BE IN CHARGE COMMENTS	ITEMS MISSING AT TIMES
46	20	SHIFT	RARELY	PATIENT CARE	NO COMMENTS	NA
32	5	WEEK	RARELY	PATIENT CARE		CHUX, IV SOLUTIONS
22	15	SHIFT	SOMETIMES	PATIENT CARE	LACK OF CHOICE OF ITEMS	URINE HATS,4X4,TOURNIQUETS
9	30	WEEK	SOMETIMES	PATIENT CARE		IV TUBING,EMESIS BASINS,SITZ,
30	60	SHIFT	NEVER	PATIENT CARE	CIV. LITTLE CONTACT W/SUPPLY	CATHETER,IV TUBING, IV FLUIDS
11	15	SHIFT	RARELY	PATIENT CARE		DELIVERY PACKS, PROBE COVERS
47	60	WEEK	SOMETIMES	ADMIN	ORDER EXACT QUANTITY	DIAPERS, OB SURG PKS, SUTURES
45	60	SHIFT	RARELY	TRAINING	LOG RUN SYSTEM, COMMO W/LOG	NA
26	480	WEEK	NEVER	SUPPLY	WARD HAS GOOD SUPPLY SYSTEM	SITZ BATHS,IV TUBING,ICE PACKS
23	0	NR	OFTEN	PATIENT CARE	6AB.91C NO CMTS	LINEN
52	10	NR	SOMETIMES	SUPPLY	NONE	OB PACKS, SPONGE BOWLS
10	15	SHIFT	SOMETIMES	PATIENT CARE	SUPPLIES ON-HAND END DAY SHIFT	INCENTIVE SPIROMETER
44	15	WEEK	NEVER	OTHER	NO COMMENTS	

SCU WARD QUESTIONNAIRE RESPONSES

RESP #	SHIFT	JOB	OUT?	WHAT DO?	STOCK?	WHERE STORED	FREQUENCY OF OUTAGE	DETERMINES STOCK LVL	WITH A SHORTAGE, WHO FINDS	WHO GETS
49	1	RN	YES	BORROW	ALL	NURSE STATION	<1/WEEK	DON'T KNOW	91C/NCOIC	91C/NCOIC
33	3	RN	YES	BORROW	NONE	NR	<1/WEEK	WARDMASTER	RN/LPN	91C/NCOIC
31	1	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	RN/LPN	91C/NCOIC
27	2	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	OTHER	RN/LPN	RN/LPN
1	1	RN	NO	NR	NR	NR	NR	WARDMASTER	NR	NR
2	1	RN	YES	BORROW	ALL	NURSE STATION	1-2/WEEK	WARDMASTER	RN/LPN	RN/LPN
13	2	RN	YES	BORROW	ALL	OTHER	<1/MONTH	WARDMASTER	91C/NCOIC	91C/NCOIC
4	5	LPN	YES	BORROW	SOME	NURSE STATION	<1/MONTH	WARDMASTER	RN/LPN	RN/LPN
53	1	91C	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	91C/NCOIC	91C/NCOIC
50	5	91C	YES	BORROW	SOME	MAIN WARD SUPPLY	<1/MONTH	OTHER	RN/LPN	RN/LPN
25	3	91C	YES	BORROW	ALL	NURSE STATION	<1/MONTH	HN	RN/LPN	RN/LPN
14	1	91C	YES	BORROW	?	MAIN WARD SUPPLY	1-2/WEEK	HN	RN/LPN	RN/LPN
28	5	ASST	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	RN/LPN	RN/LPN
24	5	ASST	YES	BORROW	SOME	NURSE STATION	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
12	2	ASST	YES	BORROW	SOME	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	RN/LPN	RN/LPN
51	1	CLERK	NR	NR	NR	NR	NR	DON'T KNOW	NR	NR

RESP #	SUPPLY TIME MIN	PER	DOES IT INTERFER	IF NOT SUPPLY, WOULD RATHER DO	IF I COULD BE IN CHARGE COMMENTS	ITEMS MISSING AT TIMES
49	30	SHIFT	OFTEN	PATIENT CARE		FINE MESH GAUZE, 2X2, 4X4
33	30	SHIFT	OFTEN	PATIENT CARE		BLOOD TUBING WARMER
31	30	SHIFT	OFTEN	PATIENT CARE	DELINEATE CMS ITEMS AVAILABLE	SM FOLEY CATH, DIAL-A-FLO
27	20	WEEK	OFTEN	PATIENT CARE	USER INVOLVEMENT,ONE COMPANY	NEEDLES,INTRACATHS,DRESSINGS
1	0	NR	NR	NR		
2	30	SHIFT	OFTEN	PATIENT CARE	EXCHANGE CART SYSTEM	IV TUBING,2X2,SLIPPERS,H2O PIT
13	10	SHIFT	RARELY	PATIENT CARE	NONE	NR
4	120	WEEK	OFTEN	PATIENT CARE	CART SYSTEM, QUICK ORDER TIME	2X2,IV TUBING, ABG KITS
53	90	SHIFT	RARELY	ADMIN		BATTERIES, NEEDLES
50	15	SHIFT	RARELY	PATIENT CARE		DON'T REMEMBER, TOO INFREQUENT
25	60	SHIFT	SOMETIMES	PATIENT CARE	SEPERATE INDIV.CHECK & STOCK	2X2,4X4 (INFREQUENTLY)
14	15	SHIFT	OFTEN	NR	NONE	NR
28	0	NR	SOMETIMES	PATIENT CARE	SUPPLIES STORED IN ONE PLACE	NEEDLES,ALCOHOL PREP,IV TUBING
24	60	SHIFT	SOMETIMES	PATIENT CARE		NEEDLES & SYRINGES, 4X4
12	30	SHIFT	OFTEN	PATIENT CARE	NONE	DRESSINGS,NEEDLES & SYRINGES
51	0	NR	NR	NR	WITH WARD SUPPLIES	NR

DISCIPLINARY BARRACKS WARD QUESTIONNAIRE RESPONSES

RESP #	SHIFT	JOB	OUT?	WHAT DO?	STOCK?	WHERE STORED	FREQUENCY OF OUTAGE	DETERMINES STOCK LVL	WITH A SHORTAGE, WHO FINDS	WHO GETS
6	1	RN	YES	BORROW	ALL	MAIN WARD SUPPLY	<1/MONTH	HN	91C/NCOIC	91C/NCOIC
5	1	91C	NO	NR	NR	NR	NR	WARDMASTER	91C/NCOIC	91C/NCOIC
8	5	91C	YES	BOSS	ALL	MAIN WARD SUPPLY	<1/WEEK	WARDMASTER	91C/NCOIC	91C/NCOIC
7	1	91B	YES	BOSS	SOME	MAIN WARD SUPPLY	<1/MONTH	WARDMASTER	91C/NCOIC	91B/ASST

RESP #	SUPPLY TIME MIN	PER	DOES IT INTERFER	IF NOT SUPPLY, WOULD RATHER DO	IF I COULD BE IN CHARGE COMMENTS	ITEMS MISSING AT TIMES
6	0	NR	RARELY	OTHER	CART EXCHANGE SYSTEM	
5	60	NR	OFTEN	NR	CART EXCHANGE SYSTEM	
8	60	WEEK	OFTEN	PATIENT CARE	NONE	4X4, SITZ BATHS
7	50	WEEK	RARELY	PATIENT CARE	CURRENT SYSTEM OK	4X4 GAUZE, XEROFORM, KERLEX

APPENDIX D

CHI-SQUARE - Patient Care Response

CHI SQUARE ANALYSIS
Patient Care Response

SOURCE: Wayne W. Daniel, Applied NonParametric Statistics
(Houghton Mifflin Co: Boston, 1978) p. 174

A Chi-Square analysis is being performed to determine whether responses concerning alternative use of supply time for 91Cs and ward clerks is significantly different from all other ward staff at the .05 level of significance.

H_o: all ward staff are homogenous (the same) in their reported alternative use of supply time
H_1: all ward personnel are not homogeneous

Alternative Use of Time *

	Patient care	>Other	
91C & clerks	6	9	15
All *other staff* *	34	7	41
	40	16	56

$$X^2 = \frac{56[(6)(7) - (34)(9)]^2}{(40)\ (16)\ (41)\ (15)} = 9.9$$

$$X^2_{a.05\ df1} = 3.841$$

Since 9.9 is greater than 3.841, I can reject the null hypothesis. 91Cs and ward clerks (primarily administrative personnel) are not the same in reporting how they will use their supply time compared with (primarily direct patient care) ward personnel.

* In order to provide adequate values in the cells, categories (uses of time and positions) were combined.

APPENDIX E

CHI-SQUARE - Supply Outage Frequency

CHI SQUARE ANALYSIS

SOURCE: Wayne W. Daniel, Applied NonParametric Statistics
(Houghton Mifflin Co: Boston, 1978) p. 174

A Chi-Square analysis is being performed to determine whether responses concerning frequency of shortages from the test ward are significantly different from other wards at the .05 level of significance.

H_o: all wards are homogeneous in their 'shortage experience'.
H_1: all wards are not homogeneous

	Frequency *		
	<1 per week	>1 per week	
Test ward	14	5	19
Other wards *	27	7	34
	41	12	53

$$X^2 = \frac{53[(14)(7) - (5)(27)]^2}{(41)\ (12)\ (19)\ (34)} = .228$$

$$X^2_{a.05\ df1} = 3.841$$

Since .228 is not greater than 3.841, I cannot reject the null hypothesis. The wards may be homogenous in their reported frequency of supply shortages.

* In order to provide adequate values in the cells, categories (frequency and wards) were combined.

APPENDIX F

Requisition/Stockage Line Item Listing

#	STOCK NUMBER	NOMENCLATURE	U/M	U/I
1	TRIANIM-112300	ABG KITS N&S 23g	100s	100 BX
2	6510008901369	ADH TAPE 1/2X10		24 PG
3	6510008901372	ADH TAPE 1X10	12s	12 PG
4	6510008901371	ADH TAPE 2X10	4s	6 PG
5	6510008901370	ADH TAPE 3X10	4s	4 PG
6	6505001060875	AMMONIA 1/3 ML	10s	10 PG
7	6515009051473	APPLICATOR WOOD DISP		2000 PG
8	GN-151130	BAG ICE	12s	12 CS
9	GN-151158	BAG ICE	12s	12 CS
10	AH-21858-030	BAG URINARY LEG TOMAC		10 BX
11	8465010939597	BAGS WATER SOLUBLE		100 BX
12	6510005977469	BAND ADHES 3/4X3 IN		100 BX
13	6510009355820	BAND COT 2INX4 1/2		12 PG
14	6510009355821	BAND COT 3INX4-1/2YDS		12 PG
15	6510009355822	BAND COT 4INX4 1/2		12 PG
16	6510009355823	BAND COT 6INX4-1/2YD		12 PG
17	6510005827992	BAND EL 4 1/2 X 5 YD	12s	12 BX
18	6510005827993	BAND ELAS 3IN/5YD	12s	12 PG
19	6510002011755	BAND MUS 37X37X52IN		1 EA
20	6530100306861	BASIN SITZ BATH		10 PG
21	6530010752723	BASIN WASH 7 QT	100s	100 PG
22	6530010490428	BEDPAN DISP.	20s	20 PG
23	651501C520120	BELT SANITARY ELASTIC		12 DZ
24	AH-43725-030	BINDER ABD 9"		1 EA
25	6530010306882	BOTTLE SPRAY 8 OZ	50s	50 PG
26	653000C951618	BRUSH BETADINE		200 BX
27	651501C520168	CATH IV 22G		1 PG
28	6515010722328	CATH IV CATHLON 18G.		50 PG
29	AH-C17750-020	CATH MEDI-EXT	12s	12 BX
30	6515010509958	CATHETER & NDL 20GA	50s	50 PG
31	653001C520286	COLLECTOR BARD CLN CATCH		1 EA
32	653001C520284	COLLECTOR SPECIMEN MS		1 EA
33	8530002236991	COMB HAIR		1 EA
34	7210007159200	COVER PILLOW PLASTIC		1 EA
35	8520002569117	CREAM SHAVING 2 OZ		1 EA
36	MUNNS-4600	CRITIKON INJ CAPS		50 BX
37	6530008377472	CUP SPEC PLAS 4-1/2OZ		100 PG
38	6530010480855	CUP SPEC UNSTER	500s	500 PG
39	6515003245500	DEPRESSOR TONGUE	100s	100 BX
40	6530001520047	DESTRUCTION UNIT SYR		1 EA
41	ABBOT-1671-02	DIALA-FLOW	48s	48 BX
42	653000C952143	DIAPER		216 CS
43	6532004933767	DIAPER TODDLER	216s	216 PG
44	MUNNS-888167002	DISPO-BOX	50s	50 CS
45	AH-43597-010	ELEVATOR ARM		1 EA
46	6530001817679	EMESIS BASIN DIS	250s	250 PG
47	6505002824618	EVAC O KIT		1 EA
48	6230001255528	FLASHLIGHT PATIENT	12s	12 PG
49	753001C520101	FORMS CLINI-TEK		1000 BX
50	650500C995703	FORMULA SMA		24 BX
51	6510010037697	GAUZE ABS 1/4X5	12s	12 PG
52	GN-487502	GAUZE STRIP 1/4X5		12 CS
53	6510011700655	GAUZE ZEROFORM 1X8		12 PG
54	6510011397535	GAUZE ZEROFORM 5X9	12s	12 PG
55	MUNNS-4053	GELCO 24 G		50 BX

56	6515004776722	GLOVE PAT EXAM MED		50	PG
57	6515007826473	GLOVES SUR DIS SZ 7		36	PG
58	6515011498841	GLOVES SURG SZ 7-1/2	50s	50	PG
59	6515011498842	GLOVES SURG SZ 8	50s	50	PG
60	6515007826476	GLOVES SURG SZ 8-1/2		36	PG
61	6530007818450	HOLDER BED PAT CARD		1	EA
62	AH-11427-010	ICE PACKS CONSTANT	20s	20	CS
63	6515007207277	INTRA INJ SE 23GA NDL		1	SE
64	6510000892791	INTRA INJ SET 21 GA		1	SE
65	6515001181341	INTRA INJ SET FLX	48s	48	PG
66	6515001150032	INTRA INJECT SET	48s	48	PG
67	6515000888868	INTRAVENOUS INJ SET		1	SE
68	AH-15906-010	IRRIG TIP SYR. 60CC	20s	20	BX
69	AH-23012-130	IV START KIT 1 TIME	50s	50	CS
70	810501C520403	LINERS BLUE SM 15X9X24		500	BX
71	810501C520404	LINERS HAMPER 25IN		100	BX
72	6505001538809	LUBRICANT SURG. KY		1	TU
73	6530000000070	MEDICINE GLASS 1 OZ	5000s	5000	PG
74	GN-451292	MONTGOMERY STRAPS		24	BX
75	6515007542838	NDL HYP DIS 21GA	100s	100	BX
76	6515007542839	NDL HYP DIS 23 GA	100s	100	BX
77	6515007542834	NDL HYP DISP 1-1/2IN		100	BX
78	6515007542836	NDL HYP DISP 20GA	100s	100	BX
79	6515007542835	NDL HYPO DISP 1IN	100s	100	BX
80	6510006555751	NEEDLE DISP 25G 5/8"	100s	100	BX
81	6515007542837	NEEDLE HYP DISP 26G	100s	100	BX
82	6515010032368	NEEDLE HYPO 20GA	1000s	1000	PG
83	6515010032369	NEEDLE HYPO 20GA	1000s	1000	PG
84	AH-30165-006	OP SITE DRES. 5X7.5	100s	100	BX
85	6510005437145	PACK PETRO 1/2X72	6s	6	PG
86	6530011190015	PAD BED LIN PROT	300s	300	PG
87	6510002998341	PAD COT GAUZE 21/2X2	50s	50	PG
88	AH-11202-017	PAD DISP DUOTHERM		10	CS
89	AH-24598	PAD HEEL	12s	12	CS
90	6510007863736	PAD ISO 1-1/2X2 IN	100s	100	PG
91	6510001110708	PAD NONADH 3X4	100s	100	PG
92	6510005596130	PAD POST-SUR-OBSTE	12s	12	PG
93	6510010100307	PAD POV-IOD IMPRE	100s	100	BX
94	6530011399506	PAD PT FOAM 36X74 IN		1	EA
95	AH-21810-010	PAD U BAG PEDS	30s	30	BX
96	NDC0003052620	PAPER NITRAZENE SQUIBB		1	EA
97	6530100923914	PAPER SHEET EXAM	12s	12	PG
98	AH-23403-015	PDI NAIL POLISH REM.	10s	10	CS
99	AH-P360	PH CONN. STER. 5ML	25s	25	BX
100	7350000433448	PITCHER WTR 32 OZ	50s	50	PG
101	AH-86-5652	PITCHER WTR W/CUP	50s	50	CS
102	6505001487096	POV-IODINE OINT	144s	144	BX
103	651501C520408	PROBE COVER IVAC		250	BX
104	6515002298172	RAZOR SURG DISP	100s	100	PG
105	651500C977180	REMOVER SKIN STAPLE DISP		12	BX
106	6530004443375	RING CUSHION		1	EA
107	8315011563545	SAFETY PINS LG	144s	144	PG
108	N/A	SAFETY PLUGS		1	EA
109	6515003638800	SCISSOR BAND 5-1/2IN		1	EA
110	6515003638840	SCISSOR BAND 7-1/4 IN		1	EA

111	6510000547254	SKIN CLOS 1/2X4	300s	300	PG
112	6510000547255	SKIN CLOS 1/4X4	500s	500	PG
113	651501c520190	SKIN STAPLES	12s	12	BX
114	6532000797902	SLIPPERS LRG SX 8-10		1	PR
115	6532000797899	SLIPPERS MED SZ 6-8		1	PR
116	6532000797889	SLIPPERS SM 4-6		1	PR
117	6532000797904	SLIPPERS XLRG SZ 10-12		1	PR
118	AH-2B7127	SODIUM CHL. .9 3000ML	4s	4	PG
119	6505010750678	SODIUM CHLORIDE 1000	12s	12	BX
120	AH-19501	SPECIMIN TRAP	20s	20	BX
121	6505011561585	STERILE WATER INFANT		12	BX
122	6515009354088	STETHO COMP TP LT WT		1	EA
123	6515011108342	STOCK ANTI-EMBO LG		1	PG
124	6515010727984	STOCK ANTI-EMBO RL		1	PR
125	6515000168230	STOCKING ANTI-EMB MED		1	PR
126	6515000168231	STOCKING ANTI-EMB SM		1	PR
127	6515008648864	STOPCOCK INTRAVENOUS		50	PG
128	AH-13615-010	STRAINER URO.		250	BX
129	6510008897020	SUSPEN SCROTAL MED	12S	12	PG
130	6510008897021	SUSPENS SCROTAL LG	12s	12	PG
131	AH-23403-03	SWAB BENZOIN 1X		100	CS
132	AH-23388	SWAB LEMON/GLYCERINE	25s	25	BX
133	6515007540412	SYR HYP 10 OR 12 ML	100s	100	PG
134	6515007244603	SYR HYP 30/35 ML	50s	50	PG
135	6515007244606	SYR HYP DISP 20ML	50s	50	PG
136	6515007540406	SYR HYP DISP 5/6ML	100s	100	BX
137	6515009824205	SYR-NDL HYP 25GA 1ML		100	PG
138	6515010585953	SYRINGE & NEEDLE	100s	100	PG
139	6530000736264	SYRINGE FOUN DIS ENEM		1	EA
140	6515004627348	SYRINGE HYPO 3ML	100s	100	PG
141	769001C521007	TAPE CHART WIDE BLUE		1	RL
142	769001C521008	TAPE CHART WIDE ORANGE		1	RL
143	6510011397544	TAPE TRANSPORE 1 INCH		12	BX
144	6510011700646	TAPE TRANSPORE 2 INCH		6	PG
145	6550001656538	TEST KIT OCCU BL	100s	100	EA
146	6550001595011	TEST KIT SYP 500 TEST		1	EA
147	8540009004891	TISSUE FACIAL		25	BX
148	AH-11798-006	TONGUE BLADE STER.		1000	CS
149	8530002902920	TOOTHBRUSH ADULT		1	EA
150	8520002569382	TOOTHPASTE		1	TU
151	6640005185462	TUBE BIO CULT.	100s	100	PG
152	6630002504264	TUBE BLD 5ML BLUE	100s	100	PG
153	6630001451534	TUBE BLD 7MM PURPLE	100s	100	PG
154	6630001451143	TUBE BLD COL 15 ML	100s	100	PG
155	6630001451137	TUBE BLD COL 7ML	100s	100	PG
156	6630011198575	TUBE BLD COLL		100	PG
157	6640011536950	TUBE CULTURE 20ML		50	BX
158	7350002442842	TUBE DRINKING		400	PG
159	AH-19893-010	TUBE FEEDING	50s	50	CS
160	6530010422485	URINAL MA PA DISP	50s	50	PG
161	AH-20370-010	VAGINAL IRRIG SET		20	BX
162	AH-10362	WASH PACK TOMAC		50	CS

APPENDIX G

THEIL TESTS - Supply Costs VS. Bed Days

THEIL TEST

SOURCE: Wayne W. Daniel, Applied NonParametric Statistics
(Houghton Mifflin Co: Boston, 1978) p. 351-353

Given information on bed days and supply costs for inpatient areas of MACH, the Med/Surg ward at MACH and some wards on a cart exchange system at St. John Hospital, I wish to test the Null hypothesis that the slope in the population regression equation between bed days and supply costs is negative or 0 at the .05 level of significance. If the slope of the line is >0, then we may conclude that there is an indication of a linear relationship between bed days and supply costs.

Theil Test (Med/Surg Ward, MACH)

Hypothesis $H_o: B = B_o$, $H_1: B > B_o$

Test Statistic:

BED DAYS	SUPPLY COSTS		Y NATURAL	Y REVERSE
400	1444		6	5
404	1263		8	2
443	2426		2	7
458	1466		4	4
470	435		7	0
471	1334		5	1
497	599		5	0
501	3098		1	3
519	1936		1	2
539	1379		2	0
593	3283		0	1
606	1641		0	0
	S=P-Q	n=12	$\overline{P}$=41	$\overline{Q}$=25

$$\hat{t} = \frac{S}{n(n-1)/2} = .242$$

$\overset{*}{t} = .394$ at a .05

TEST: Reject H_o if $\hat{t} > \overset{*}{t}$ $\quad .242 \not> .394$

Not enough evidence to reject Null hypothesis.

The slope of the population regressions line may very well be zero or negative. There is no evidence of a linear relationship between bed days and supply costs on the Med/Surg Ward at MACH.

Theil Test (MACH)

Hypothesis $H_o: B = B_o$, $H_1: B > B_o$

Test Statistic:

BED DAYS	SUPPLY COSTS		Y NATURAL	Y REVERSE
777	5280		9	2
796	5640		7	3
865	6157		5	4
874	7797		2	6
904	5296		5	2
907	3555		6	0
923	7359		2	3
944	6766		2	2
945	6285		1	2
950	9560		0	2
1002	4167		1	0
1115	6032		0	0
	S=P-Q	n=12	$\overline{P}$=40	$\overline{Q}$=26

$$\hat{t} = \frac{S}{n(n-1)\ /2} = .212$$

$\tilde{t} = .394$ at a $_{.05}$

TEST: Reject H_o if $\hat{T} > \tilde{t}$ $\quad .212 \not> .394$

Not enough evidence to reject Null hypothesis.
The slope of the population regression line may very well be zero or negative. There is no evidence of a linear relationship between bed days and supply costs on the Med/Surg Ward at MACH.

Theil Test (St Johns Hospital)

Hypothesis $H_o: B = B_o$, $H_1: B > B_o$

Test Statistic:

BED DAYS	SUPPLY COSTS	Y NATURAL	Y REVERSE
751	1388	8	0
837	1500	5	2
915	1481	5	1
949	1473	5	0
965	1607	4	0
973	2214	0	3
995	2099	0	2
1032	1654	1	0
1087	2004	1	0
		P=28	Q=8

$S = P-Q \quad n=4$

$$\hat{t} = \frac{S}{n(n-1)/2} = .556$$

$\overset{*}{t} = .5$ at a $_{.05}$

TEST: Reject H_o if $\hat{t} > \overset{*}{t}$ $\quad .556 > .5$

There is evidence at the a .05 level of significance that there is a positive slope in the population regression line. There is evidence of a linear relationship between bed days and supply costs at St. John Hospital.

APPENDIX H

MASTER SPREADSHEET

MASTER SPREADSHEET
Explanatory Notes

CODE #	- Refers to item on Line Item List (App. F).
UNIT $	- current replacement cost
#/UNIT	- number of units of measure (U/M) in a unit of issue (U/I)
QTY INV	- number of U/I inventoried on test ward
QTY/YEAR	- number of U/M ordered during 12 month period
YR/COST	- item cost for year's purchases
INV $	- cost of inventory
USE/OBD	- QTY/YEAR divided by Occupied Bed Days (5901)
AUTH INV	- 2 weeks authorized stockage
INV PAR U/M	- AUTH INV taken to next higher U/M
COST/INV PAR	- Cost of 2 weeks inventory in U/M
INV/DR	- 2 weeks authorized stockage in U/I
COST/INV DR	- Cost of 2 weeks inventory under Direct Requisition (U/I)

CODE #	UNIT $	#/UNIT	QTY INV	QTY/YEAR	YR/COST	INV $
1	110.00	100	0	1	110	0.00
2	3.82	24	0	2	7.64	0.00
3	3.82	12	20	9	34.38	6.37
4	3.82	6	6	7	26.74	3.82
5	3.82	4	0	1	3.82	0.00
6	1.29	10	1	3	3.87	0.13
7	14.59	2000	500	1	14.59	3.65
8	43.05	12	48	1	43.05	172.20
9	53.00	12	28	1	53	123.67
10	28.90	10	8	1	28.9	23.12
11	59.95	100	150	5	299.75	89.93
12	4.41	100	500	22	97.02	22.05
13	4.73	12	0	3	14.19	0.00
14	6.11	12	22	5	30.55	11.20
15	7.22	12	31	4	28.88	18.65
16	10.52	12	21	55	578.6	18.41
17	9.62	12	25	36	346.32	20.04
18	5.17	12	0	8	41.36	0.00
19	1.12	1	11	96	107.52	12.32
20	15.38	10	6	3	46.14	9.23
21	41.63	100	16	7	291.41	6.66
22	15.98	20	13	10	159.8	10.39
23	8.66	12	24	7	60.62	17.32
24	7.09	1	5	5	35.45	35.45
25	15.35	50	77	1	15.35	23.64
26	96.35	200	1	2	192.7	0.48
27	47.15	1	117	12	565.8	5516.55
28	51.00	50	83	6	306	84.66
29	10.41	12	0	3	31.23	0.00
30	38.49	50	154	5	192.45	118.55
31	0.94	1	6	192	180.48	5.64
32	0.81	1	32	382	309.42	25.92
33	0.07	1	5	229	16.03	0.35
34	0.83	1	0	55	45.65	0.00
35	0.61	1	5	31	18.91	3.05
36	28.75	50	25	3	86.25	14.38
37	7.67	100	100	11	84.37	7.67
38	22.27	500	0	1	22.27	0.00
39	0.66	100	200	3	1.98	1.32
40	8.45	1	5	5	42.25	42.25
41	145.92	48	8	11	1605.12	24.32
42	79.00	216	0	1	79	0.00
43	26.14	216	72	3	78.42	8.71
44	40.50	50	11	1	40.5	8.91
45	9.00	1	8	20	180	72.00
46	18.00	250	300	8	144	21.60
47	2.65	1	10	20	53	26.50
48	6.20	12	12	10	62	6.20
49	45.80	1000	0	2	91.6	0.00
50	0.01	24	12	3	0.03	0.01
51	11.44	12	30	2	22.88	28.60

CODE #	USE/OBD 5901	AUTH INV (2 WEEK)	INV/PAR U/M	COST/INV PAR/CES	INV/DR U/I	COST/INV DR:U/I
1	0.02	3.85	4	4.40	1	110
2	0.01	1.85	2	0.32	1	3.82
3	0.02	4.15	5	1.59	1	3.82
4	0.01	1.62	2	1.27	1	3.82
5	0.00	0.15	1	0.96	1	3.82
6	0.01	1.15	2	0.26	1	1.29
7	0.34	76.92	77	0.56	1	14.59
8	0.00	0.46	1	3.59	1	43.05
9	0.00	0.46	1	4.42	1	53
10	0.00	0.38	1	2.89	1	28.9
11	0.08	19.23	20	11.99	1	59.95
12	0.37	84.62	85	3.75	1	4.41
13	0.01	1.38	2	0.79	1	4.73
14	0.01	2.31	3	1.53	1	6.11
15	0.01	1.85	2	1.20	1	7.22
16	0.11	25.38	26	22.79	3	31.56
17	0.07	16.62	17	13.63	2	19.24
18	0.02	3.69	4	1.72	1	5.17
19	0.02	3.69	4	4.48	5	5.6
20	0.01	1.15	2	3.08	1	15.38
21	0.12	26.92	27	11.24	1	41.63
22	0.03	7.69	8	6.39	1	15.98
23	0.01	3.23	4	2.89	1	8.66
24	0.00	0.19	1	7.09	2	14.18
25	0.01	1.92	2	0.61	1	15.35
26	0.07	15.38	16	7.71	1	96.35
27	0.00	0.46	1	47.15	2	94.3
28	0.05	11.54	12	12.24	1	51
29	0.01	1.38	2	1.74	1	10.41
30	0.04	9.62	10	7.70	1	38.49
31	0.03	7.38	8	7.52	9	8.46
32	0.06	14.69	15	12.15	16	12.96
33	0.04	8.81	9	0.63	10	0.7
34	0.01	2.12	3	2.49	4	3.32
35	0.01	1.19	2	1.22	3	1.83
36	0.03	5.77	6	3.45	1	28.75
37	0.19	42.31	43	3.30	1	7.67
38	0.08	19.23	20	0.89	1	22.27
39	0.05	11.54	12	0.08	1	0.66
40	0.00	0.19	1	8.45	2	16.9
41	0.09	20.31	21	63.84	1	145.92
42	0.04	8.31	9	3.29	1	79
43	0.11	24.92	25	3.03	1	26.14
44	0.01	1.92	2	1.62	1	40.5
45	0.00	0.77	1	9.00	2	18
46	0.34	76.92	77	5.54	1	18
47	0.00	0.77	1	2.65	2	5.3
48	0.02	4.62	5	2.58	1	6.2
49	0.34	76.92	77	3.53	1	45.8
50	0.01	2.77	3	0.00	1	0.01
51	0.00	0.92	1	0.95	1	11.44

52	38.16	12	CMS		2	76.32	0.00
53	7.30	12		10	4	29.2	6.08
54	11.24	12		0	7	78.68	0.00
55	99.00	50		58	2	198	114.84
56	6.13	50		300	97	594.61	36.78
57	8.69	36		100	4	34.76	24.14
58	15.02	50		50	4	60.08	15.02
59	15.02	50		36	4	60.08	10.81
60	8.69	36		0	2	17.38	0.00
61	4.64	1		12	40	185.6	55.68
62	79.76	20		0	3	239.28	0.00
63	0.25	1		12	128	32	3.00
64	0.25	1		12	2	0.5	3.00
65	43.43	48		84	8	347.44	76.00
66	29.47	48		89	22	648.34	54.64
67	2.92	1		25	13	37.96	73.00
68	19.90	20		0	2	39.8	0.00
69	72.50	50		46	7	507.5	66.70
70	38.20	500		520	8	305.6	39.73
71	63.66	100		75	9	572.94	47.75
72	0.57	1		4	14	7.98	2.28
73	32.78	5000		1600	4	131.12	10.49
74	37.33	24		2	3	111.99	3.11
75	2.33	100		239	12	27.96	5.57
76	2.33	100		156	9	20.97	3.63
77	2.33	100		263	8	18.64	6.13
78	2.33	100		412	6	13.98	9.60
79	2.33	100		200	21	48.93	4.66
80	2.33	100		44	7	16.31	1.03
81	2.33	100		124	1	2.33	2.89
82	50.23	1000		915	3	150.69	45.96
83	51.53	1000		0	3	154.59	0.00
84	53.90	100		28	5	269.5	15.09
85	103.15	6		0	4	412.6	0.00
86	22.03	300		400	24	528.72	29.37
87	3.37	50		100	2	6.74	6.74
88	67.00	10		0	2	134	0.00
89	24.78	12		3	1	24.78	6.20
90	0.84	100		200	141	118.44	1.68
91	4.02	100	CMS		1	4.02	0.00
92	0.64	12		8	183	117.12	0.43
93	2.22	100		300	18	39.96	6.66
94	10.03	1		8	49	491.47	80.24
95	18.30	30		62	2	36.6	37.82
96	6.83	1		0	2	13.66	0.00
97	11.10	12		9	2	22.2	8.33
98	41.75	100		1080	2	83.5	450.90
99	18.42	25		0	1	18.42	0.00
100	40.18	50		0	30	1205.4	0.00
101	28.50	50		62	1	28.5	35.34
102	9.97	144		222	2	19.94	15.37
103	12.25	250		500	99	1212.75	24.50
104	15.85	100		25	2	31.7	3.96
105	41.97	12		12	8	335.76	41.97

52	38.16	12 CMS		2	76.32	0.00
53	7.30	12	10	4	29.2	6.08
54	11.24	12	0	7	78.68	0.00
55	99.00	50	58	2	198	114.84
56	6.13	50	300	97	594.61	36.78
57	8.69	36	100	4	34.76	24.14
58	15.02	50	50	4	60.08	15.02
59	15.02	50	36	4	60.08	10.81
60	8.69	36	0	2	17.38	0.00
61	4.64	1	12	40	185.6	55.68
62	79.76	20	0	3	239.28	0.00
63	0.25	1	12	128	32	3.00
64	0.25	1	12	2	0.5	3.00
65	43.43	48	84	8	347.44	76.00
66	29.47	48	89	22	648.34	54.64
67	2.92	1	25	13	37.96	73.00
68	19.90	20	0	2	39.8	0.00
69	72.50	50	46	7	507.5	66.70
70	38.20	500	520	8	305.6	39.73
71	63.66	100	75	9	572.94	47.75
72	0.57	1	4	14	7.98	2.28
73	32.78	5000	1600	4	131.12	10.49
74	37.33	24	2	3	111.99	3.11
75	2.33	100	239	12	27.96	5.57
76	2.33	100	156	9	20.97	3.63
77	2.33	100	263	8	18.64	6.13
78	2.33	100	412	6	13.98	9.60
79	2.33	100	200	21	48.93	4.66
80	2.33	100	44	7	16.31	1.03
81	2.33	100	124	1	2.33	2.89
82	50.23	1000	915	3	150.69	45.96
83	51.53	1000	0	3	154.59	0.00
84	53.90	100	28	5	269.5	15.09
85	103.15	6	0	4	412.6	0.00
86	22.03	300	400	24	528.72	29.37
87	3.37	50	100	2	6.74	6.74
88	67.00	10	0	2	134	0.00
89	24.78	12	3	1	24.78	6.20
90	0.84	100	200	141	118.44	1.68
91	4.02	100 CMS		1	4.02	0.00
92	0 94	12	8	183	117.12	0.43
93	22	100	300	18	39.96	6.66
94	10.03	1	8	49	491.47	80.24
95	18.30	30	62	2	36.6	37.82
96	6.83	1	0	2	13.66	0.00
97	11.10	12	9	2	22.2	8.33
98	41.75	100	1080	2	83.5	450.90
99	18.42	25	0	1	18.42	0.00
100	40.18	50	0	30	1205.4	0.00
101	28.50	50	62	1	28.5	35.34
102	9.97	144	222	2	19.94	15.37
103	12.25	250	500	99	1212.75	24.50
104	15.85	100	25	2	31.7	3.96
105	41.97	12	12	8	335.76	41.97

106	11.94	1		0	2	23.88	0.00
107	2.85	144		0	10	28.5	0.00
108	1.07	1		0	2	2.14	0.00
109	7.51	1		0	10	75.1	0.00
110	11.45	1		0	5	57.25	0.00
111	17.94	300		40	2	35.88	2.39
112	17.94	500		0	2	35.88	0.00
113	41.97	12		0	3	125.91	0.00
114	0.30	1		30	405	121.5	9.00
115	0.28	1		65	200	56	18.20
116	0.26	1		25	100	26	6.50
117	0.31	1		30	375	116.25	9.30
118	21.28	4		19	8	170.24	101.08
119	9.69	12	PHAR		4	38.76	0.00
120	40.94	20		19	1	40.94	38.89
121	0.01	12		48	2	0.02	0.04
122	4.65	1		0	13	60.45	0.00
123	8.28	1		5	29	240.12	41.40
124	3.53	1		0	15	52.95	0.00
125	6.33	1		4	30	189.9	25.32
126	6.33	1		7	19	120.27	44.31
127	29.56	50		33	8	236.48	19.51
128	19.15	250		75	1	19.15	5.75
129	23.62	12		0	1	23.62	0.00
130	23.26	12		0	1	23.26	0.00
131	51.85	100		60	1	51.85	31.11
132	5.55	25		75	21	116.55	16.65
133	7.57	100		21	9	68.13	1.59
134	9.73	50		9	3	29.19	1.75
135	7.55	50		28	2	15.1	4.23
136	11.73	100		168	11	129.03	19.71
137	5.03	100		55	4	20.12	2.77
138	4.92	100		410	9	44.28	20.17
139	0.84	1		16	119	99.96	13.44
140	4.03	100		800	35	141.05	32.24
141	5.62	1		1	6	33.72	5.62
142	5.62	1		1	8	44.96	5.62
143	13.70	12		37	29	397.3	42.24
144	13.06	6		23	12	156.72	50.06
145	13.96	100		50	1	13.96	6.98
146	52.62	1		0	1	52.62	0.00
147	21.10	25		210	5	105.5	177.24
148	30.80	1000		0	1	30.8	0.00
149	0.12	1		22	179	21.48	2.64
150	0.27	1		1	269	72.63	0.27
151	14.55	100		100	1	14.55	14.55
152	7.11	100		30	2	14.22	2.13
153	7.17	100		100	1	7.17	7.17
154	6.70	100		150	3	20.1	10.05
155	5.35	100		150	5	26.75	8.03
156	5.64	100		0	4	22.56	0.00
157	72.85	50		30	5	364.25	43.71
158	1.51	400		400	12	18.12	1.51
159	121.00	50		42	1	121	101.64

106	11.94	1	0	2	23.88	0.00
107	2.85	144	0	10	28.5	0.00
108	1.07	1	0	2	2.14	0.00
109	7.51	1	0	10	75.1	0.00
110	11.45	1	0	5	57.25	0.00
111	17.94	300	40	2	35.88	2.39
112	17.94	500	0	2	35.88	0.00
113	41.97	12	0	3	125.91	0.00
114	0.30	1	30	405	121.5	9.00
115	0.28	1	65	200	56	18.20
116	0.26	1	25	100	26	6.50
117	0.31	1	30	375	116.25	9.30
118	21.28	4	19	8	170.24	101.08
119	9.69	12 PHAR		4	38.76	0.00
120	40.94	20	19	1	40.94	38.89
121	0.01	12	48	2	0.02	0.04
122	4.65	1	0	13	60.45	0.00
123	8.28	1	5	29	240.12	41.40
124	3.53	1	0	15	52.95	0.00
125	6.33	1	4	30	189.9	25.32
126	6.33	1	7	19	120.27	44.31
127	29.56	50	33	8	236.48	19.51
128	19.15	250	75	1	19.15	5.75
129	23.62	12	0	1	23.62	0.00
130	23.26	12	0	1	23.26	0.00
131	51.85	100	60	1	51.85	31.11
132	5.55	25	75	21	116.55	16.65
133	7,57	100	21	9	68.13	1.59
134	9.73	50	9	3	29.19	1.75
135	7.55	50	28	2	15.1	4.23
136	11.73	100	168	11	129.03	19.71
137	5.03	100	55	4	20.12	2.77
138	4.92	100	410	9	44.28	20.17
139	0.84	1	16	119	99.96	13.44
140	4.03	100	800	35	141.05	32.24
141	5.62	1	1	6	33.72	5.62
142	5.62	1	1	8	44.96	5.62
143	13.70	12	37	29	397.3	42.24
144	13.06	6	23	12	156.72	50.06
145	13.96	100	50	1	13.96	6.98
146	52.62	1	0	1	52.62	0.00
147	21.10	25	210	5	105.5	177.24
148	30.80	1000	0	1	30.8	0.00
149	0.12	1	22	179	21.48	2.64
150	0.27	1	1	269	72.63	0.27
151	14.55	100	100	1	14.55	14.55
152	7.11	100	30	2	14.22	2.13
153	7.17	100	100	1	7.17	7.17
154	6.70	100	150	3	20.1	10.05
155	5.35	100	150	5	26.75	8.03
156	5.64	100	0	4	22.56	0.00
157	72.85	50	30	5	364.25	43.71
158	1.51	400	400	12	18.12	1.51
159	121.00	50	42	1	121	101.64

160	15.13	50	45	11	166.43	13.62
161	34.85	20	2	2	69.7	3.49
162	20.05	50	18	1	20.05	7.22
				ANN $	21288.93	9102.14

160	0.09	21.15	22	6.66	1	15.13
161	0.01	1.54	2	3.49	1	34.85
162	0.01	1.92	2	0.80	1	20.05
				1020.75		3812.96

ANNUAL SUPPLY COSTS	21288.93	# ITEMS AT 0 BALANCE	34
INVENTORY COSTS.....	9102.14	% LINES 0 BALANCE	21%
INV TURNS PER YR...	2.34		
MONTHS STOCK OH...	5.13		
$ 2 WK U/I	3812.96		
$ 2 WK U/M	1020.75		

APPENDIX I

SUPPLY CART INFORMATION

EXCHANGE CARTS — Series ECN

SERIES ECN-B EXCHANGE CARTS

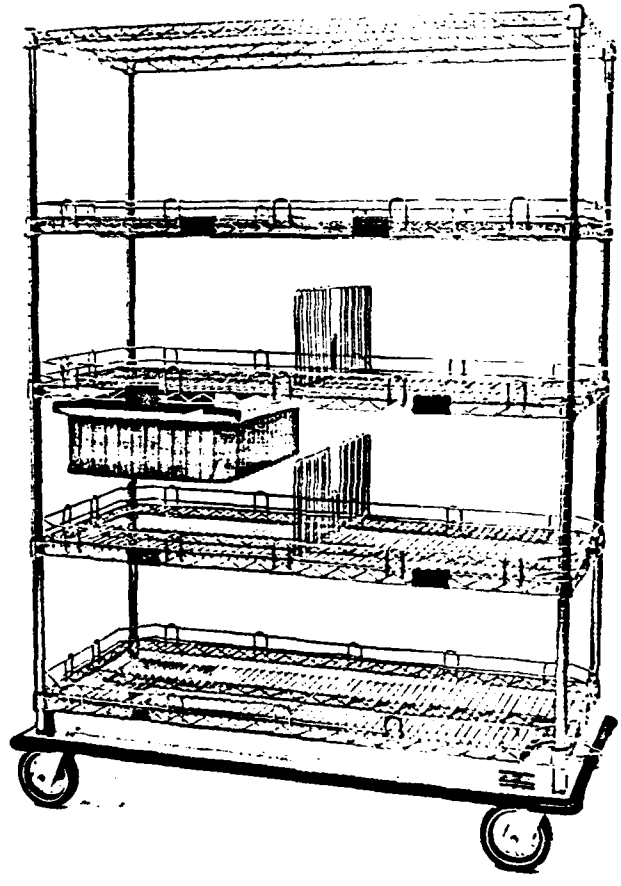
ECN-B Series exchange carts are intended for use in a medium-duty supply-transfer or exchange cart application. These carts consist of a chrome-plated wire shelving unit mounted on an aluminum dolly frame equipped with a wraparound bumper and four six-inch swivel casters — two C6L and two C6LSL (with swivel lock). Each cart comes complete with:

Four-sided, one-inch high shelf ledges.*

Eight-inch movable shelf dividers.*

Undershelf drawers with sufficient dividers to provide nine compartments per drawer. (Undershelf drawer slides included.)*

Six shelf markers.*



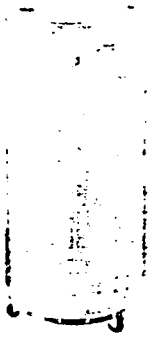
*NOTE: See Section 36 for these and other accessories.

Model No	Shelf Width (in.)	Shelf Length (in.)	Overall Height (in.)	No. of Shelves	No. of 4-Sided Ledges	No. of Shelf Dividers	No. of Undershelf Drawers
ECN455C-B	21	48	61	4	3	2	1
ECN465C-B	21	60	61	4	3	3	2
ECN456C-B	21	48	70	5	4	2	1
ECN466C-B	21	60	70	5	4	3	2

NOTE: Consult your InterMetro representative for cart-washing applications.

SOILED LINEN CONTAINERS (31.20)

Model No.	Price	(a) Diameter (in.)	(a) Diameter (mm)	(b) Height (in.)	(b) Height (mm)	Approx. Wt (lbs.)	Approx. Wt (kg)
S9831A w/casters	206.00	18	455	33	840	11	5
S92031A w/casters	223.00	20	510	33	840	15½	7



COVERS

Cover Dia. (in.)	Cover Dia. (mm)	Flat Cover Model No.	Flat Cover Price	Flat Cover Approx. Wt (lbs.)	Flat Cover Approx. Wt (kg)	Sanitation Cover Model No	Sanitation Cover Price	Sanitation Cover Approx. Wt (lbs.)	Sanitation Cover Approx. Wt (kg)
18	455	A8A	45.70	1½	.70	A14A	54.50	2	1.0
20	510	A10A	48.90	2	1.0	A15A	68.40	3	1.4

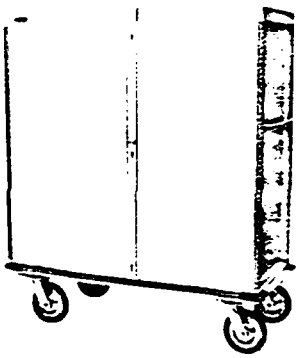
ENCLOSED SUPPLY CARTS (31.25, 34.25)

With Flap Cat. No.	With Flap Price	With Door Cat. No.	With Door Price	Height (in.) Inside	Height (in.) Outside	Depth (in.) Inside	Depth (in.) Outside	Length (in.) Inside	Length (in.) Outside
T523A	1187.00	T524A	1233.00	30 9/16	42 13/16	22	24 5/8	32½	39
T543A	1460.00	T544A	1571.00	45 9/16	61 1/16	22	24 5/8	47	53½
T563A	1894.00			51 13/16	66½	22	24 5/8	58	64½

ADDITIONAL SHELVES

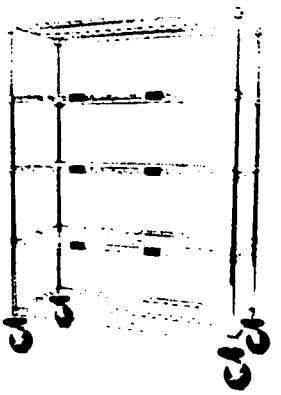
Cat. No.	*Price*	*Fits*
2232FA	58.00	Small Cart
2247FA	77.30	Medium Cart
2258FA	111.00	Large Cart

LAUNDRY & SUPPLY CARTS



SUPER ERECTA SHELF®

EXCHANGE CARTS — SERIES ECN (30.01, 31.01, 33.01, 34.01)



SERIES ECN–A

With 21" wide chrome-plated wire shelves, 5" stem casters (two with brakes), and six shelf markers.

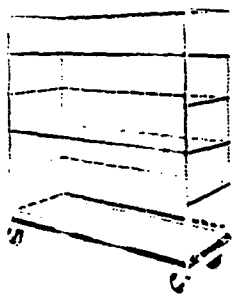
Cat. No.	Price	Overall Height (in.)	Overall Height (mm)	Shelf Length (in.)	Shelf Length (mm)	No. of Shelves
ECN455C-A	327.00	60	1525	48	1220	4
ECN465C-A	364.00	60	1525	60	1525	4
ECN456C-A	384.00	69	1753	48	1220	5
ECN466C-A	430.00	69	1753	60	1525	5

SERIES ECN–B

With 21" wide chrome-plated wire shelves, an aluminum dolly frame with wraparound bumper, 6" plate casters (two with swivel locks), and six shelf markers.

Cat. No.	Price	Overall Height (in.)	Overall Height (mm)	Shelf Length (in.)	Shelf Length (mm)	No. of Shelves	No. of 4-Sided Ledges	No. of Shelf Dividers	No. of Undershelf Drawers
ECN455C-B	885.00	61	1550	48	1220	4	3	2	1
ECN465C-B	1055.00	61	1550	60	1525	4	3	3	2
ECN456C-B	1009.00	70	1778	48	1220	5	4	2	1
ECN466C-B	1199.00	70	1778	60	1525	5	4	3	2

METRO



HEAVY DUTY

LINEN
CARTS & TRUCKS

CONVERTIBLE LINEN TRUCK (31.12)

Model No.	Price	Description	Shelf Size Width (in.)	Shelf Size Length (in.)	Height (in.)	Approx Pkd Wt (lbs.)
STANDARD-DUTY — CHROME						
CLTS2460C	1371.00	CLT with 3-sided top frame	24	60	70	200
CLT4S2460C	1383.00	CLT with 4-sided top frame	24	60	70	207
CLTS2448C	1256.00	CLT with 3-sided top frame	24	48	70	180
CLT4S2448C	1264.00	CLT with 4-sided top frame	24	48	70	185
STANDARD-DUTY — STAINLESS STEEL						
CLT2460S	1894.00	CLT with 3-sided top frame	24	60	70	169
CLT42460S	1929.00	CLT with 4-sided top frame	24	60	70	173
HEAVY-DUTY — CHROME						
CLTH2460C	1551.00	CLT with 3-sided top frame	24	60	70	241
CLT4H2460C	1559.00	CLT with 4-sided top frame	24	60	70	247

MATERIAL: Chrome Models: chrome plated steel dolly and aluminum tubes.
Stainless Steel: stainless steel dolly and aluminum tubes.

Note 1: Casters on above units consist of two 6P and one pair BL6P. 8P and BL8P available on special order.

Note 2: Before employing any of various cart-washing systems, please contact InterMetro Industries Corporation or your InterMetro representative for special recommendations on casters and for cleaning instructions.

ACCESSORIES

Model		Price
CLCHC	Card Holder	9.20
PH24NC	Push Handle	13.80

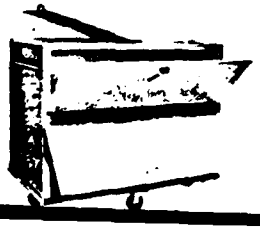
COVERS* FOR CONVERTIBLE LINEN TRUCK (31.12)

Width (in.)	Width (mm)	Length (in.)	Length (mm)	Height (in.)	Height (mm)	UNCOATED Cat. No	UNCOATED Price	COATED Cat. No	COATED Price
24	610	48	1220	62	1575	24X48X62UC	97.80	24X48X62C	145.00
24	610	60	1525	62	1575	24X60X62UC	114.00	24X60X62C	159.00

*Cart covers are non-returnable.

SOILED LINEN CART (31.15)

Model No	Price		Height (in.)	Height (mm)	Width (in.)	Width (mm)	Length (in.)	Length (mm)	Approx. Wt. (lbs.)	Approx. Wt. (kg)
T68A	1506.00	Overall	46¼	1185	32¼	820	56	1420	108	49
		Inside	38¼	970	30	760	50	1270		



ACCESSORIES

Model		Price	Model		Price
BC5N/R	5" Extra Heavy-Duty Neoprene-Tired Casters	72.00*	WB8	Wheel Brake on B5 Series Caster	14.70 ea.
BC8L/R	8" Extra Heavy-Duty Gray Rubber-Tired Casters	114.80*	WB9	Wheel Brake on C6, C8 Series Caster	21.10 ea.
CBAIR/R	Extra Heavy-Duty	353.20*			

COVERS for Shelf Carts and Shelf Trucks

DIMENSIONS

UNCOATED COVERS

Width (in.)	Width (mm)	Length (in.)	Length (mm)	Height (in.)	Height (mm)	Cat. No.
18	455	36	910	54	1370	18X36X54UC
18	455	36	910	62	1575	18X36X62UC
18	455	48	1220	54	1370	18X48X54UC
18	455	48	1220	62	1575	18X48X62UC
18	455	60	1520	54	1370	18X60X54UC
18	455	60	1520	62	1575	18X60X62UC
21	530	48	1220	54	1370	21X48X54UC
21	530	48	1220	62	1575	21X48X62UC
21	530	48	1220	74	1880	21X48X74UC
21	530	60	1520	54	1370	21X60X54UC
21	530	60	1520	62	1575	21X60X62UC
21	530	60	1520	74	1880	21X60X74UC
24	610	36	910	54	1370	24X36X54UC
24	610	36	910	62	1575	24X36X62UC
24	610	36	910	74	1880	24X36X74UC
24	610	36	910	86	2185	24X36X86UC
24	610	48	1220	54	1370	24X48X54UC
24	610	48	1220	62	1575	24X48X62UC
24	610	48	1220	74	1880	24X48X74UC
24	610	48	1220	86	2185	24X48X86UC
24	610	60	1525	54	1370	24X60X54UC
24	610	60	1525	62	1575	24X60X62UC
24	610	60	1525	74	1880	24X60X74UC
24	610	60	1525	86	2185	24X60X86UC
24	610	72	1820	54	1370	24X72X54UC
24	610	72	1820	62	1575	24X72X62UC
24	610	72	1820	74	1880	24X72X74UC
24	610	72	1820	86	2185	24X72X86UC

NOTE: Standard sizes listed. Other sizes available.

DIMENSIONS

COATED COVERS

Width (in.)	Width (mm)	Length (in.)	Length (mm)	Height (in.)	Height (mm)	Cat. No.
18	455	36	910	54	1370	18X36X54C
18	455	36	910	62	1575	18X36X62C
18	455	48	1220	54	1370	18X48X54C
18	455	48	1220	62	1575	18X48X62C
18	455	60	1520	54	1370	18X60X54C
18	455	60	1520	62	1575	18X60X62C
21	530	48	1220	54	1370	21X48X54C
21	530	48	1220	62	1575	21X48X62C
21	530	48	1220	74	1880	21X48X74C
21	530	60	1520	54	1370	21X60X54C
21	530	60	1520	62	1575	21X60X62C
21	530	60	1520	74	1880	21X60X74C
24	610	36	910	54	1370	24X36X54C
24	610	36	910	62	1575	24X36X62C
24	610	36	910	74	1880	24X36X74C
24	610	36	910	86	2185	24X36X86C
24	610	48	1220	54	1370	24X48X54C
24	610	48	1220	62	1575	24X48X62C
24	610	48	1220	74	1880	24X48X74C
24	610	48	1220	86	2185	24X48X86C
24	610	60	1525	54	1370	24X60X54C
24	610	60	1525	62	1575	24X60X62C
24	610	60	1525	74	1880	24X60X74C
24	610	60	1525	86	2185	24X60X86C
24	610	72	1820	54	1370	24X72X54C
24	610	72	1820	62	1575	24X72X62C
24	610	72	1820	74	1880	24X72X74C
24	610	72	1820	86	2185	24X72X86C

NOTE: Standard sizes listed. Other sizes available.

InterMetro Industries Corporation
Wilkes-Barre, PA 18705

APPENDIX J

PERSONNEL COST INFORMATION

PERSONNEL COST INFORMATION

POSITION	RN	LPN	91C	91B	ASST	CLERK	TOT.MIN.	HRS/YEAR
MINUTES PER WEEK	165	75	480	135	115	0	970	4219.50
MINUTES PER SHIFT	260	120	660	68	3	15	1126	700.00
TOT HRS	879.38	400.85	2498.30	629.52	502.12	9.33		4919.50

1 FTE = 2088 HRS

****

WAGE COMPARISONS

GRADE	MOS/Title	WAGE/HR	Tot. Hrs	TOTAL $	
E4 /4yrs	91B	5.11	629.52	3217.52	
GS3/5	679 CLERK	5.98	9.33	55.79	
E6 /8yrs	91C	6.59	2498.30	16475.13	
GS5/1	621 LPN	6.66	400.85	2669.66	
GS5/1	620 ASST	6.66	502.12	3344.12	
GS9/8	610 RN	12.39	879.38	10895.52	
03 /8yrs	66H	12.46	*	0.00	
		[TOTALS]	4919.50	$36657.74	2.36 FTEs

Personnel Trade-offs			Hours	Annual Wage	
WG4/5	WHSE	10.55	2088.00	$22028.40	
GS3/5	SUP CLK	5.98	2088.00	$12486.24	
		Total	4176	$34514.64	2.00 FTEs
		dif.	743.50	$2143.10	